IBA

TECHNICAL REVIEW

2

Blank pages in this document were not scanned so there may be occasional gaps in the page sequence.

Technical Reference Book

1977

IBA
INDEPENDENT
BROADCASTING
AUTHORITY

The Engineering Division of the IBA aims to be in the forefront of technical development and, where practicable, to take advantage of the latest techniques in day-to-day operations.

For this reason the working tolerances and other figures quoted in IBA Specifications, Codes of Practice, etc. are revised from time to time, and it is therefore important always to refer to the most recent issue.

May 1977

IBA TECHNICAL REVIEW
ISSN 0308-423X

2 Technical Reference Book

Contents

Technical Editor: C W B Reis, BSc, IBA Engineering Information Service

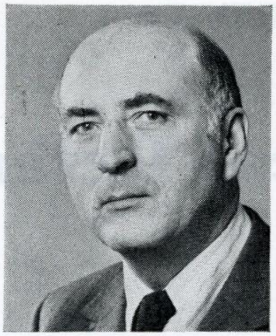
Additional Copies

Subject to availability, further copies of this IBA Technical Review may be obtained on application to Engineering Information Service, IBA, Crawley Court, WINCHESTER, Hants SO21 2QA.
No charge will be made for small quantities.

1st edition *September 1972*
2nd edition *July 1974*
3rd edition *May 1977*

IBA INDEPENDENT BROADCASTING AUTHORITY
70 Brompton Road London SW3 1EY *Tel: 01-584 7011 Telex: 24345*

Introduction



by T S Robson OBE
Deputy Director of Engineering
Independent Broadcasting Authority

From modest beginnings, the Authority has grown to become one of the world's major broadcasting organisations. Governed by the Independent Broadcasting Authority Act 1973, it builds, owns and operates the transmitters which carry all the Independent Broadcasting services throughout the United Kingdom. At the present time these comprise a vhf network of 47 transmitters, bringing 98.7% of the population within range of the 405-line black-and-white television service; a rapidly growing uhf network providing the 625-line colour service and currently numbering 273 transmitters which is increasing at the rate of approximately one transmitter per week towards an eventual total exceeding 600, even though the present population coverage has already reached the 97.7% level; and a system of 39 vhf and mf transmitters providing Independent Local Radio (ILR) services in the 18 areas so far authorised by the Government and in all serving about 45% of the population. In planning these Independent Local Radio services, it was envisaged that there would eventually be a total of up to 60 such areas each with its own independent service.

In addition, since June 1975, most of the 625-line colour television signals produced in London by either Thames Television, London Weekend Television or Independent Television News have also provided an experimental ORACLE teletext service to standards which have been agreed jointly between the IBA, the British Radio Equipment Manufacturers' Association (BREMA), the Independent Television Companies' Association (ITCA) and the British Broadcasting Corporation (BBC). Until now this service, which is fully described in *IBA Technical Review 9*, has been largely confied to the London area. It has only been available in the regions, when they are carrying London originated programmes, but it will shortly become available in all regions for most of the time.

In addition to owning and operating the transmitters, the IBA is responsible for the technical quality of all ITV and ILR transmissions from their point of origination, be this a studio or an OB unit, right through to their final transmission from the furthest relay station. This all adds up to a major broadcasting engineering operation involving much organisation, planning, design, construction, maintenance and control.

With an engineering undertaking of this size, the maintaining of high standards as a matter of daily routine becomes as complex as it is vital. For this reason, the IBA's Quality Control Section was set up in 1968 to recommend and establish appropriate standards of technical performance, and to maintain constant surveillance during daily operations. This section, working in close collaboration with other engineering departments within the IBA, as well as with the programme companies, other broadcasting organisations and equipment manufacturers, is responsible for preparing most of the material contained in this volume.

The result, therefore, is a reference book dealing with the facts and figures of the IBA's everyday operation and containing technical data, specifications and codes of practice used throughout the IBA's television, radio and data broadcasting services. While the present edition contains much information which is little changed from the two earlier editions, it includes two sections of entirely new material. Furthermore, the Code of Practice for Independent Local Radio has been greatly modified and extended.

It is hoped that all who use this edition of *IBA Technical Review* will find it helpful and of value in upholding the technical standards of broadcasting practice.

Specification of Television Standards for 625-line System I Transmissions

Synopsis
The coming of three-channel 625-line colour television in the United Kingdom at the end of the sixties represented something of a watershed in the history of television. Investment by the public and the broadcasters in colour television increased massively and the demands for equipment, from receivers to cameras, reached record heights as the new service spread throughout the country. One result of this, from the point of view of the manufacturers and broadcasters, was that a need which had existed for some time was now becoming increasingly manifest—the need for an agreed specification for the System I 625-line PAL signal used in the United Kingdom. A standardisation was required of the signal characteristics, together with their permitted tolerances and distortions.
In January 1971, the IBA and the BBC jointly published this specification which was the outcome of some two-and-a-half years of discussion between the organisations primarily concerned, the BBC, BREMA, EEA, IBA, ITCA, PO and RSA. It has since become a valuable asset to broadcasters, equipment designers and manufacturers, and also represents an important United Kingdom contribution to the international work of the CCIR.

1. INTRODUCTION

The purpose of this specification is to detail the PAL colour television system in accordance with the 625-line System I employed within the UK and to indicate some of the tolerances permitted in the generation, processing and transmission of the signal.

Sections 2 and 3 are concerned with the system characteristics of the vision signals, including specification of the synchronising and blanking waveforms.

Section 4 specifies the form of the picture information in the vision signal, while Section 5 describes the synthesis of colour picture information from the red, green and blue signal voltages in a colour camera.

Section 6 gives the ideal radio frequency characteristics of the sound and vision components.

Appendix I presents information on the various types of colour bar signal used for alignment and testing of colour television equipment with tables showing the amplitudes of the picture components of primary colours and their complements. Appendix II reiterates the colour signal identities of Section 5 in matrix form and Appendix III gives details of the nature and application of the insertion signals. The estimated performance of the overall system is given in Appendix IV.

2. VIDEO CHARACTERISTICS

2.0 Picture Signal

The picture signal shall correspond to the scanning of the image at uniform velocities from left to right and from top to bottom.

2.1 Number of Lines per Picture

The number of lines per picture shall be 625. During source synchronising operations there may be an addition or deletion of one line per field for a brief period (1–5 seconds).

2.2 Interlace

The interlace ratio shall be 2 to 1.

2.3 Aspect Ratio

The ratio of image width to image height within the picture area shall be 4 to 3.

2.4 Gamma

The gamma of the transmitted signal shall be related to a display gamma of 2.8 ± 0.3.

2.5 Colour Sub-carrier Frequency

The frequency of the colour sub-carrier shall be:
$f_{sc} = 4.43361875$ MHz ± 1 Hz.
Where the signal originates from an overseas source, the tolerance on this frequency may be relaxed to ± 5 Hz.

The maximum rate of change of sub-carrier frequency shall be 0.1 Hz/s. During source

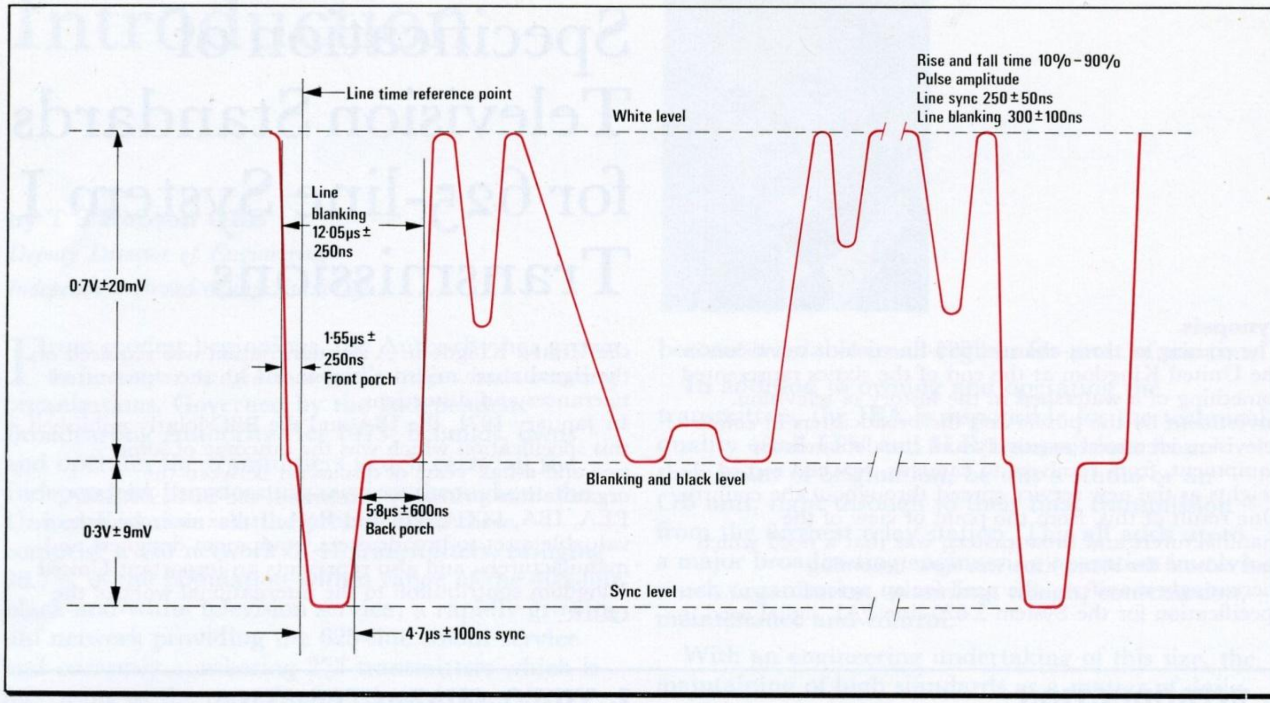


Fig. 1. The waveform of a typical line showing synchronising signals. Pulse duration is measured at half-amplitude points. Blanking duration is measured at half-amplitude points with a white level signal of line duration and for this reason the picture signal has been shown starting and finishing at the white level.

synchronising operations there will be small phase perturbations which may cause the frequency and its rate of change to deviate beyond these limits for short periods (1–5 seconds).

2.6 Relationship between Colour Sub-carrier Frequency and Line Frequency

The line scanning frequency shall be a sub-multiple of the colour sub-carrier frequency, the exact relationship being:

$$f_h = \frac{4f_{sc}}{1135 + \frac{4}{625}}$$

With f_{sc} as in Section 2.5:

$f_h = 15.625$ kHz.

The converse relationship is:

$f_{sc} = (284 - \frac{1}{4})\, f_h + 25$ Hz.

Under some conditions, where the signal is derived from an overseas standard or where the reference of synchronism is being changed, this relationship may not apply. Under these conditions:

$f_h = 15.625$ kHz $\pm 0.01\%$

and the sub-carrier frequency shall conform to Section 2.5 above.

2.7 Field Frequency

The field scanning frequency shall be:

$$f_{\text{field}} = \frac{2}{625} \times f_h$$

2.8 Video Bandwidth

The normal video bandwidth shall be 5.5 MHz.

3. SYNCHRONISING AND BLANKING WAVEFORMS

The horizontal and vertical synchronising and blanking waveforms shall be as specified in Figs. 1 and 2 which show a typical signal at the point of origination.

The colour burst blanking waveforms shall be as described in Section 4.4.4 and the colour burst position as shown in Section 4.4 and Figs. 12 and 13.

4. THE VIDEO SIGNAL

4.0 Tolerances

The tolerances in this Section apply to the waveform at the point of programme origination, which is defined as all the apparatus in a studio centre from

the coder to the studio centre output, including video tape recorders. (See Appendix IV, Column D.)

4.1 General Specification

The colour picture signal shall comprise a luminance (brightness) component and a pair of chrominance (colouring) components transmitted simultaneously as the amplitude modulation sidebands of a pair of suppressed sub-carriers in phase quadrature having a common frequency as defined in Section 2.5. The phase of one of these sub-carriers is commutated through 180° after the end of each line, yielding a colour signal conforming to the system generally known as Phase Alternation Line (PAL).

A monochrome picture signal contains the luminance (brightness) component only.

4.2 Luminance Component

An increase in the incident light intensity shall correspond to an increase in the amplitude of the video signal. For a colour signal, the relationship between the spectral composition of the incident light and the luminance amplitude shall be as defined in Section 5.2.

4.2.1 AMPLITUDE-FREQUENCY CHARACTERISTICS
The amplitude-frequency characteristic of the luminance signal shall be substantially uniform from 0 to 5.5 MHz except where it may be modified in the region embracing the sub-carrier frequency by the use of a notch filter in the coder. See Fig. 3.

4.3 Chrominance Component

The chrominance signal shall correspond to the sideband components of two amplitude modulated

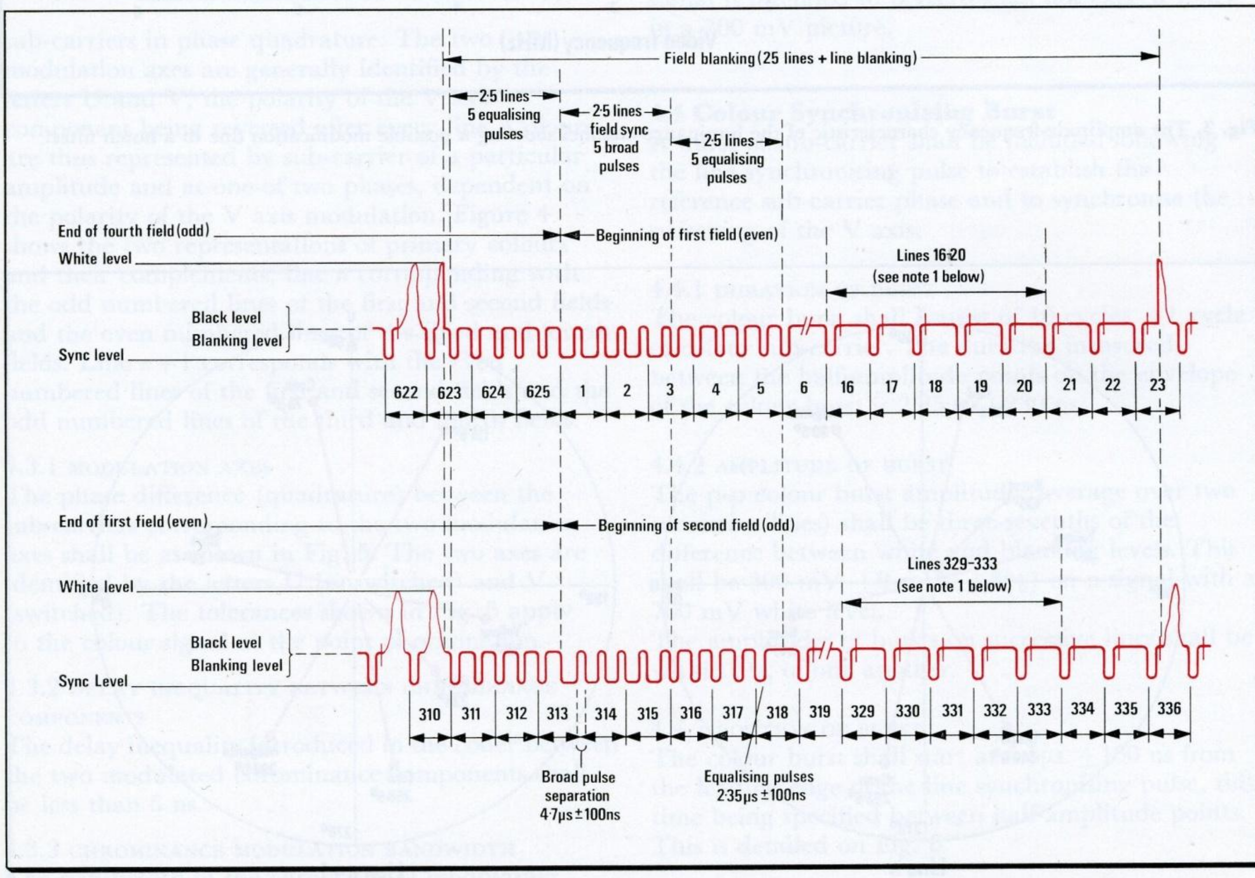


Fig. 2. Vertical synchronising and blanking waveforms for a typical signal. Lines 7–14 and 320–327 have been omitted. Rise and fall times are from 10% to 90% of the pulse amplitude and for the field blanking are 300 ± 100 ns, and for the field sync pulses and the equalising pulses the rise and fall times are ± 50 ns.
Note 1: Lines 16–20 may contain identification control or test signals (see Appendix III).
Note 2: The first and second fields are identical with the third and fourth in all respects except burst blanking (see Section 4.4.4).

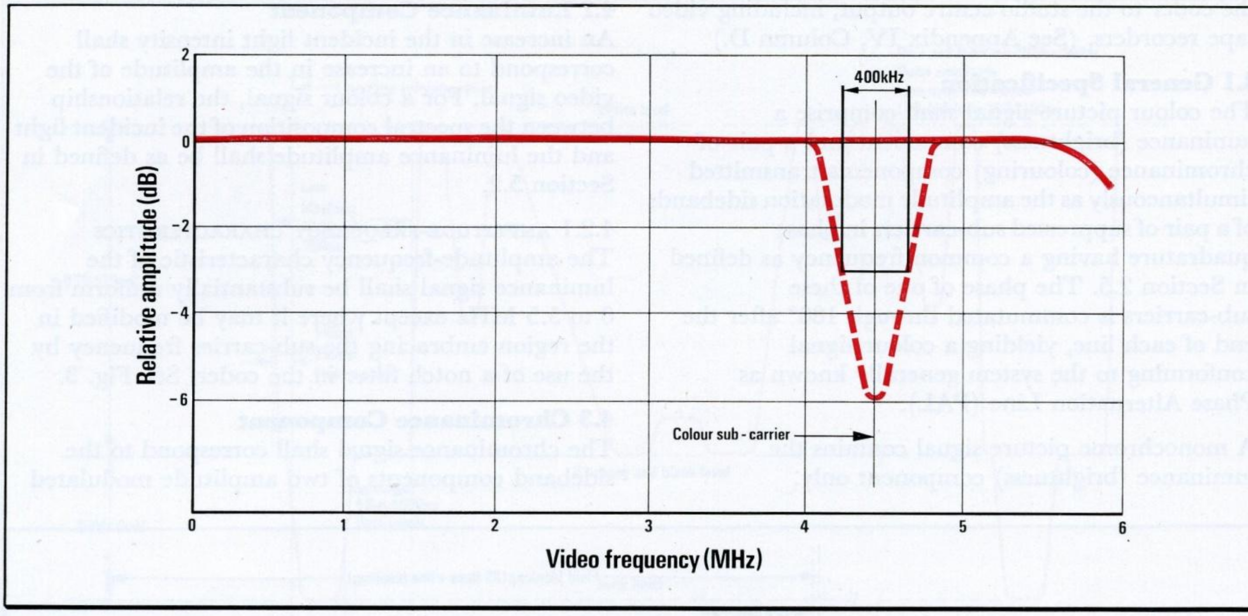


Fig. 3. The amplitude-frequency characteristic of the luminance channel showing a possible modification due to a notch filter.

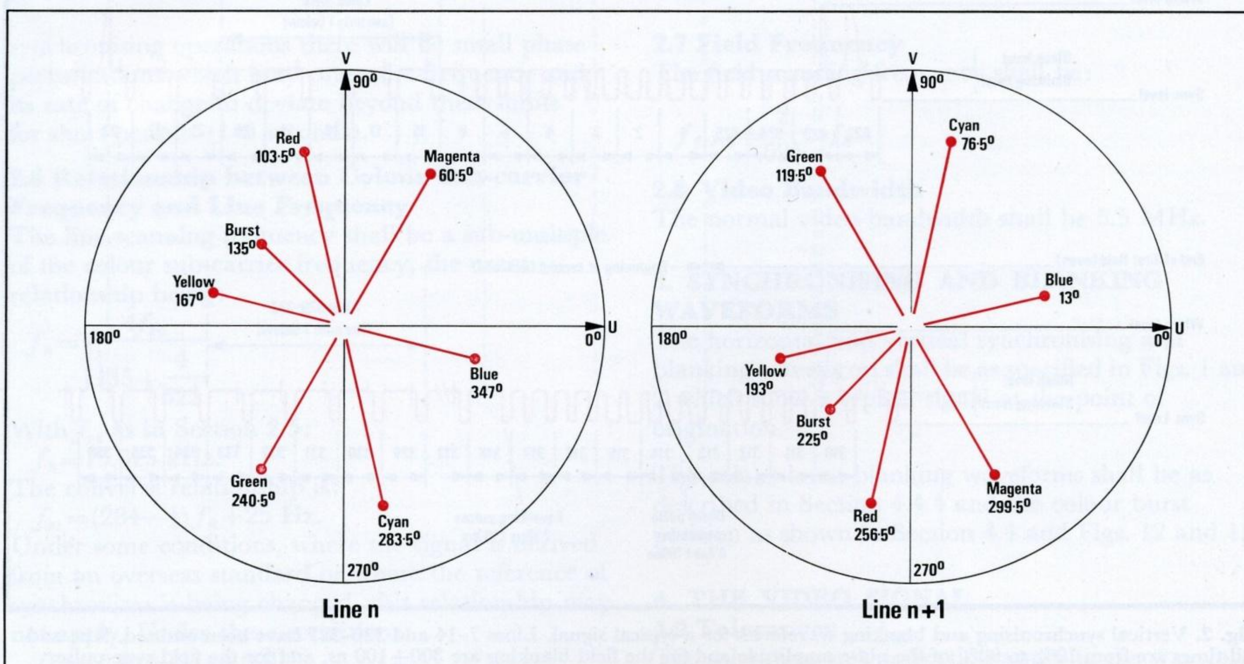


Fig. 4. The phases of sub-carrier representing primary colours and their complements on alternate lines of the PAL colour system.

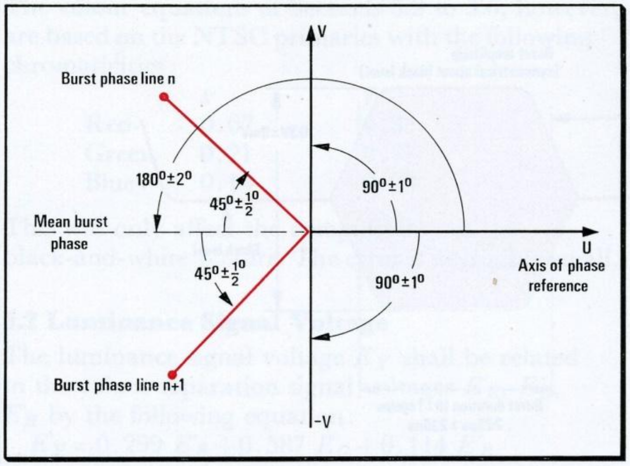


Fig. 5. The phases of sub-carrier for the two modulation axes.

sub-carriers in phase quadrature. The two modulation axes are generally identified by the letters U and V, the polarity of the V axis component being reversed after every line. Colours are thus represented by sub-carrier of a particular amplitude and at one of two phases, dependent on the polarity of the V axis modulation. Figure 4 shows the two representations of primary colours and their complements, line *n* corresponding with the odd numbered lines of the first and second fields and the even numbered lines of the third and fourth fields. Line $n+1$ corresponds with the even numbered lines of the first and second fields and the odd numbered lines of the third and fourth fields.

4.3.1 MODULATION AXES

The phase difference (quadrature) between the sub-carriers corresponding to the two modulation axes shall be as shown in Fig. 5. The two axes are identified by the letters U (unswitched) and V (switched). The tolerances shown in Fig. 5 apply to the colour signal at the point of origination.

4.3.2 DELAY INEQUALITY BETWEEN CHROMINANCE COMPONENTS

The delay inequality introduced in the coder between the two modulated chrominance components shall be less than 5 ns.

4.3.3 CHROMINANCE MODULATION BANDWIDTH

The bandwidth of the chrominance modulating video signals (see Section 5.4) shall be constrained by the following conditions:

at 1.3 MHz <3 dB attenuation relative to low frequencies.

at 4 MHz >20 dB attenuation relative to low frequencies.

The form of this characteristic shall be approximately Gaussian. The modulating process shall not modify these bandwidths. Nevertheless, the upper chrominance sideband will be subsequently restricted by the nominal video bandwidth of 5.5 MHz.

4.3.4 COLOUR DISPLAY ON ZERO CHROMINANCE SIGNAL

It is intended that zero chrominance signal should produce a display chromaticity of CIE Illuminant D_{6500}, i.e.,

$x=0.313, \quad y=0.329.$

4.3.5 RESIDUAL SUB-CARRIER

The p-p sub-carrier level when the chrominance signal is intended to be zero shall not exceed 7 mV in a 700 mV picture.

4.4 Colour Synchronising Burst

A burst of sub-carrier shall be included following the line synchronising pulse to establish the reference sub-carrier phase and to synchronise the switching of the V axis.

4.4.1 DURATION OF BURST

The colour burst shall consist of 10 cycles ± 1 cycle of colour sub-carrier. The duration measured between the half-amplitude points on the envelope of the colour burst is 2.25μs ± 230 ns.

4.4.2 AMPLITUDE OF BURST

The p-p colour burst amplitude (average over two successive lines) shall be three-sevenths of the difference between white and blanking levels. This shall be 300 mV ± 9 mV ($\pm 3\%$) on a signal with a 700 mV white level.

The amplitudes of bursts on successive lines shall be within 5% of one another.

4.4.3 POSITION OF BURST

The colour burst shall start at 5.6μs ± 100 ns from the leading edge of the line synchronising pulse, this time being specified between half-amplitude points. This is detailed on Fig. 6.

4.4.4 FIELD INTERVAL BLANKING

Colour burst shall be omitted during nine lines of each field blanking interval in the manner shown on Fig. 7.

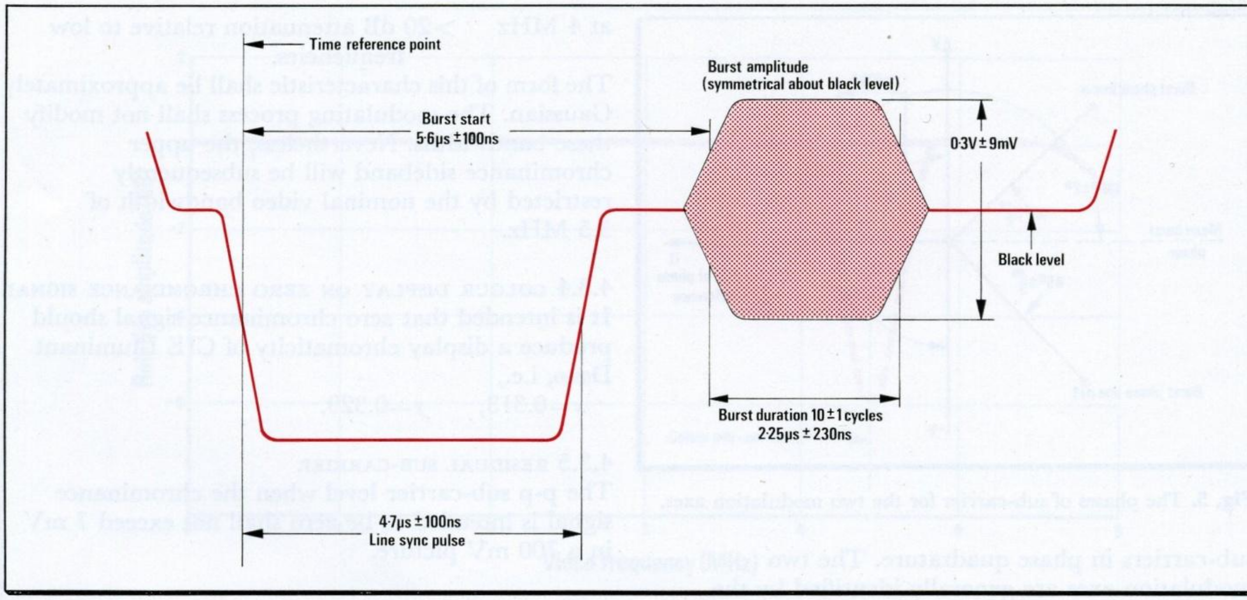


Fig. 6. The colour burst on a standard level signal (700 mV white level).

4.4.5 BANDWIDTH OF BURST

The pulse used to produce the colour burst shall be subjected to the same bandwidth specification prior to modulation as a chrominance signal. See Section 4.3.3. This gives an approximate burst risetime of 300 ns.

4.4.6 RELATIONSHIP BETWEEN BURST AMPLITUDE AND CHROMINANCE SIGNAL AMPLITUDE

The relationship between the burst amplitude and the chrominance signal amplitude shall be accurate to ±11%. This tolerance is required because the amplitude of the burst may be used to indicate the intended saturation of the picture.

4.4.7 ANGULAR POSITION OF COLOUR BURST

Relative to the +U modulation axis, on odd lines of the first and second fields and even lines of the third and fourth fields, the phase of the colour burst shall be +135°. On even lines of the first and second fields and odd lines of the third and fourth fields, the phase of the colour burst shall be +225°. The mean burst phase shall be 180° ±2° from the reference axis. See Fig. 5.

4.5 Signal Excursions at Decoder Output

The composite picture signal shall be such that the red, green, and blue outputs from a colour decoder shall lie between their values at 0% (black) and 100% (white).

5. COLOUR SIGNAL EQUATIONS

5.1 Primary Colour Chromaticities

Two sets of primary colour chromaticity coordinates are quoted in this Section. The first set, which represents the phosphors in a typical current colour display tube, dictates the nature of the colour analysis characteristics of the colour camera. The second set represents the primaries decided upon by the NTSC, with due regard to the phosphors then in use; these phosphors have not been retained in display tubes because of limited brightness capability but are retained as the basis of colour processing relationships.

E_R', E_G' and E_B' are the gamma-corrected voltages corresponding to red, green and blue signals during the scanning of a picture element.

These voltages are intended for use with a colour picture tube having phosphors with the following chromaticities according to the CIE system of specifications:

	x	y
Red	0.64	0.33
Green	0.29	0.60
Blue	0.15	0.06

The colour equations of Sections 5.2 to 5.6, however, are based on the NTSC primaries with the following chromaticities:

	x	y
Red	0.67	0.33
Green	0.21	0.71
Blue	0.14	0.08

This will only affect the compatibility of the black-and-white picture. The error is negligibly small.

5.2 Luminance Signal Voltage

The luminance signal voltage E'_Y shall be related to the colour separation signal voltages E'_R, E'_G, E'_B by the following equation:

$$E'_Y = 0.299\ E'_R + 0.587\ E'_G + 0.114\ E'_B$$

5.3 Colour Difference Signal Voltage

The colour-difference signal voltage shall be defined by the equations:

$$E'_R - E'_Y = 0.701\ E'_R - 0.587\ E'_G - 0.114\ E'_B$$
$$E'_B - E'_Y = -0.299\ E'_R - 0.587\ E_G + 0.886\ E_B$$

These equations are derived from Section 5.2.

5.4 Chrominance Modulating Signal Voltage

The two chrominance modulating signal voltages E'_U and E'_V shall be derived from the equations:

$$E'_U = 0.493\ (E'_B - E'_Y)$$
$$E'_V = 0.877\ (E'_R - E'_Y)$$

These equations apply only for frequencies within the chrominance bandwidth. See Section 4.3.3.

5.5 Equation for the Modulated Chrominance Signal

The modulated chrominance signal shall be defined by the equations:

$$u = E'_U \sin \omega t$$
$$v_n = E'_V \cos \omega t \text{ (line } n \text{ only)}$$
$$v_{n+1} = -E'_V \cos \omega t \text{ (line } n+1 \text{ only)}$$

where:

$\omega = 2\pi f_{sc}$

E'_U is the peak chrominance voltage along the reference axis.

E'_V is the peak chrominance voltage in quadrature with the reference axis.

Line n refers to the odd lines of the first and second

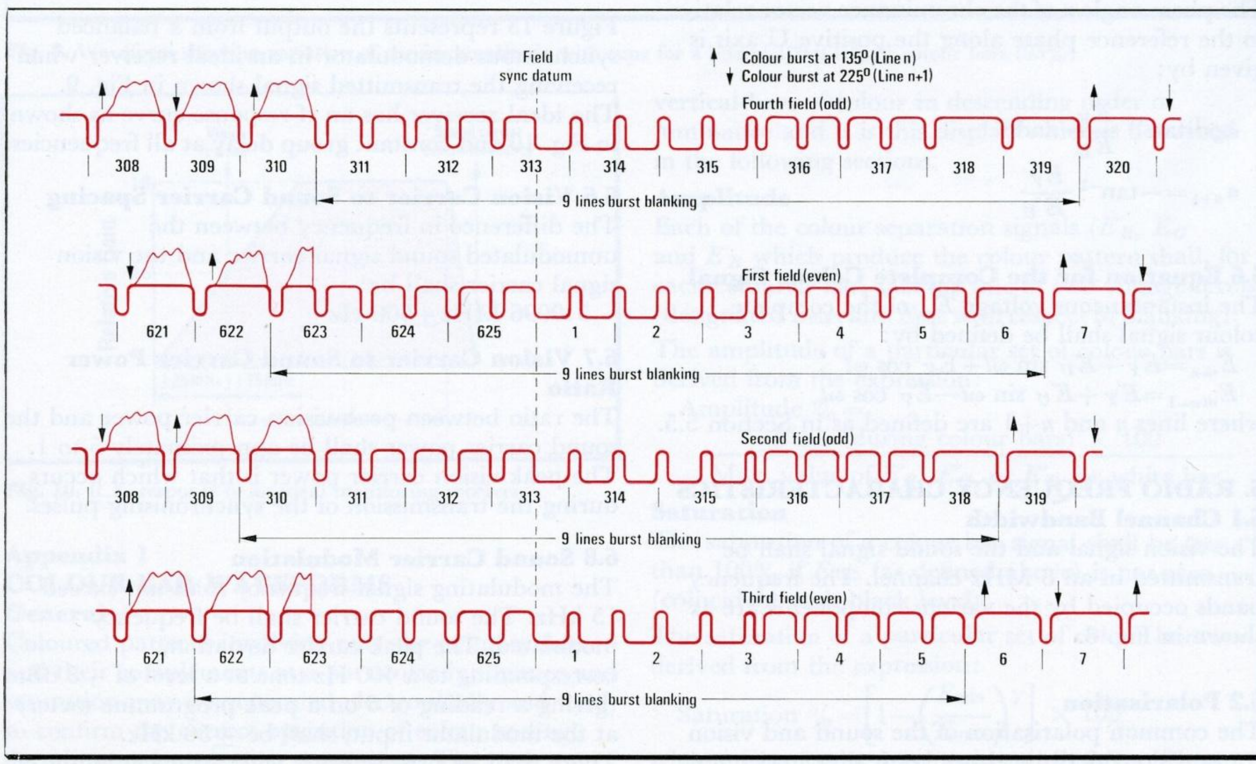


Fig. 7. Field interval blanking of the colour burst.

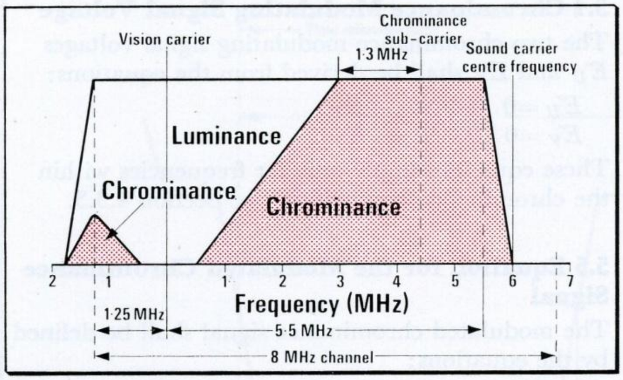


Fig. 8. The frequency bands occupied by the colour picture components and sound signal from an ideal transmitter.

fields and the even lines of the third and fourth fields. Line $n+1$ refers to the even lines of the first and second fields and the odd lines of the third and fourth fields. (See Section 4.4.7 and Fig. 5.)

The p-p chrominance amplitude (2S) is given by the equation:

$$2S = 2\sqrt{(E'_U)^2 + (E'_V)^2}$$

The phase angle α of the chrominance vector relative to the reference phase along the positive U axis is given by:

$$\alpha_n = \tan^{-1}\frac{E'_V}{E'_U} \text{ and}$$

$$\alpha_{n+1} = -\tan^{-1}\frac{E'_V}{E'_U}$$

5.6 Equation for the Complete Colour Signal

The instantaneous voltage E_m of the complete colour signal shall be defined by:

$$E_{m\,n} = E'_Y + E'_U \sin \omega t + E'_V \cos \omega t$$

$$E_{m\,n+1} = E'_Y + E'_U \sin \omega t - E'_V \cos \omega t$$

where lines n and $n+1$ are defined as in Section 5.5.

6. RADIO FREQUENCY CHARACTERISTICS

6.1 Channel Bandwidth

The vision signal and the sound signal shall be transmitted in an 8 MHz channel. The frequency bands occupied by the various components are as shown in Fig. 8.

6.2 Polarisation

The common polarisation of the sound and vision transmissions shall be either vertical or horizontal as dictated by geographical location.

6.3 Asymmetric-Sideband Vision Transmission Characteristics

The nominal vision transmission characteristics shall be as follows:

The bandwidth of the upper sideband shall be 5.5 MH.

The bandwidth of the lower sideband shall be 1.25 MHz.

Ideally, the delay characteristic of the transmitted waveform should be uniform, there being no correction for receiver delay characteristics.

6.4 Vision Carrier Modulation

The vision carrier shall be amplitude modulated with negative polarity.

6.5 Vision Carrier Envelope

The idealised carrier amplitude as a function of time shall be as shown in Fig. 9 with reference to a particular colour bar test signal. The 1.3% and 95% carrier levels embrace the entire gamut of chrominance signals encountered with the PAL system. The transmitted carrier amplitude at black level and white level may vary by up to ±2%.

Figure 13 represents the output from a balanced synchronous demodulator in an ideal receiver when receiving the transmitted signal shown in Fig. 9. The ideal receiver has an rf response curve as shown in Fig. 10 and constant group delay at all frequencies.

6.6 Vision Carrier to Sound Carrier Spacing

The difference in frequency between the unmodulated sound signal carrier and the vision signal carrier shall be:

5.9996 MHz ±500 Hz

6.7 Vision Carrier to Sound Carrier Power Ratio

The ratio between peak vision carrier power and the sound carrier power shall be apprpximately 5 to 1. The peak vision carrier power is that which occurs during the transmission of the synchronising pulses.

6.8 Sound Carrier Modulation

The modulating signal frequency shall not exceed 15 kHz. The sound carrier shall be frequency modulated. The peak carrier deviation, corresponding to a 400 Hz tone at a level of +8 dBm (giving a reading of 6 on a peak programme meter) at the modulator input, shall be ±50 kHz.

There shall be pre-emphasis with a time constant of 50 μs.

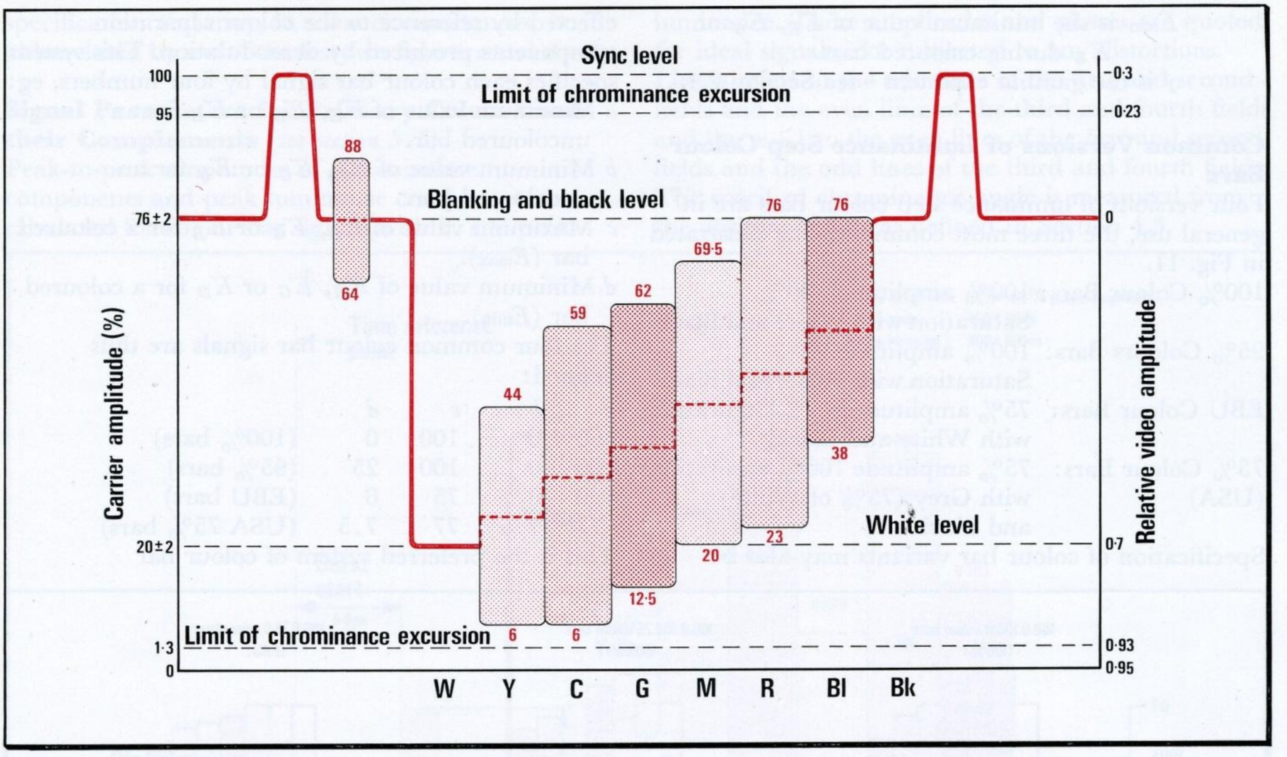


Fig. 9. Waveform showing variation of carrier amplitude with time for a line of 100.0.100.25 colour bars (95%).

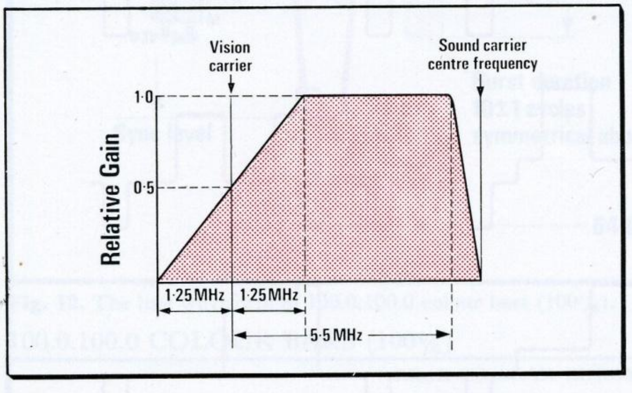


Fig. 10. R.F. response of an ideal monitoring receiver.

Appendix 1
COLOUR BAR WAVEFORMS
General

Coloured patterns involving only the primary hues and their complements at a particular luminance and saturation may be generated electronically and used to confirm the correct operation of colour coding, decoding and processing equipment. The most common form of these patterns comprises several vertical bars of colour in descending order of luminance and it is this display which is described in the following sections.

Amplitude

Each of the colour separation signals (E'_R, E'_G and E'_B which produce the colour pattern shall, for each coloured bar, take up one of two voltage levels (designated $E_{\max}$ and $E_{\min}$ with respect to blanking). The amplitude of a particular set of colour bars is derived from the expression:

$$\text{Amplitude }\% = \frac{E'_{\max}\text{ (during colour bars)} \times 100}{\text{Max. value of } E'_R,\ E'_G, \text{ or } E'_B \text{ for white bar.}}$$

Saturation

The saturation of a colour bar signal shall be less than 100% if $E_{\min}$ (as defined above) is not zero (coincident with black level).

The saturation of a particular set of colour bars is derived from the expression:

$$\text{Saturation }\% = \left[1 - \left(\frac{E_{\min}}{E_{\max}}\right)^{\gamma}\right] \times 100$$

where: $E_{\max}$ is the maximum value of E'_R, E'_G or E'_B during coloured bars.

E_{min} is the minimum value of E'_R, E'_G or E'_B during coloured bars.

γ is the gamma exponent – see Section 2.4.

Common Versions of Luminance Step Colour Bars

Four versions of luminance step colour bars are in general use, the three most common being illustrated in Fig. 11.

100% Colour Bars: 100% amplitude 100% Saturation with White and Black.

95% Colours Bars: 100% amplitude 95% Saturation with White and Black.

EBU Colour Bars: 75% amplitude 100% Saturation with White and Black.

75% Colour Bars: (USA) 75% amplitude 100% Saturation with Grey (75% of White) and Black.

Specification of colour bar variants may also be effected by reference to the colour separation components produced by demodulation. This system specifies each colour bar signal by four numbers, eg:

a Maximum value of E'_R, E'_G or E'_B for an uncoloured bar.

b Minimum value of E'_R, E'_G or E'_B for an uncoloured bar.

c Maximum value of E'_R, E'_G or E'_B for a coloured bar (E_{max}).

d Minimum value of E'_R, E'_G or E'_B for a coloured bar (E_{min}).

The four common colour bar signals are thus defined:

a	*b*	*c*	*d*	
100	0	100	0	(100% bars)
100	0	100	25	(95% bars)
100	0	75	0	(EBU bars)
77	7.5	77	7.5	(USA 75% bars)

This is the preferred system of colour bar

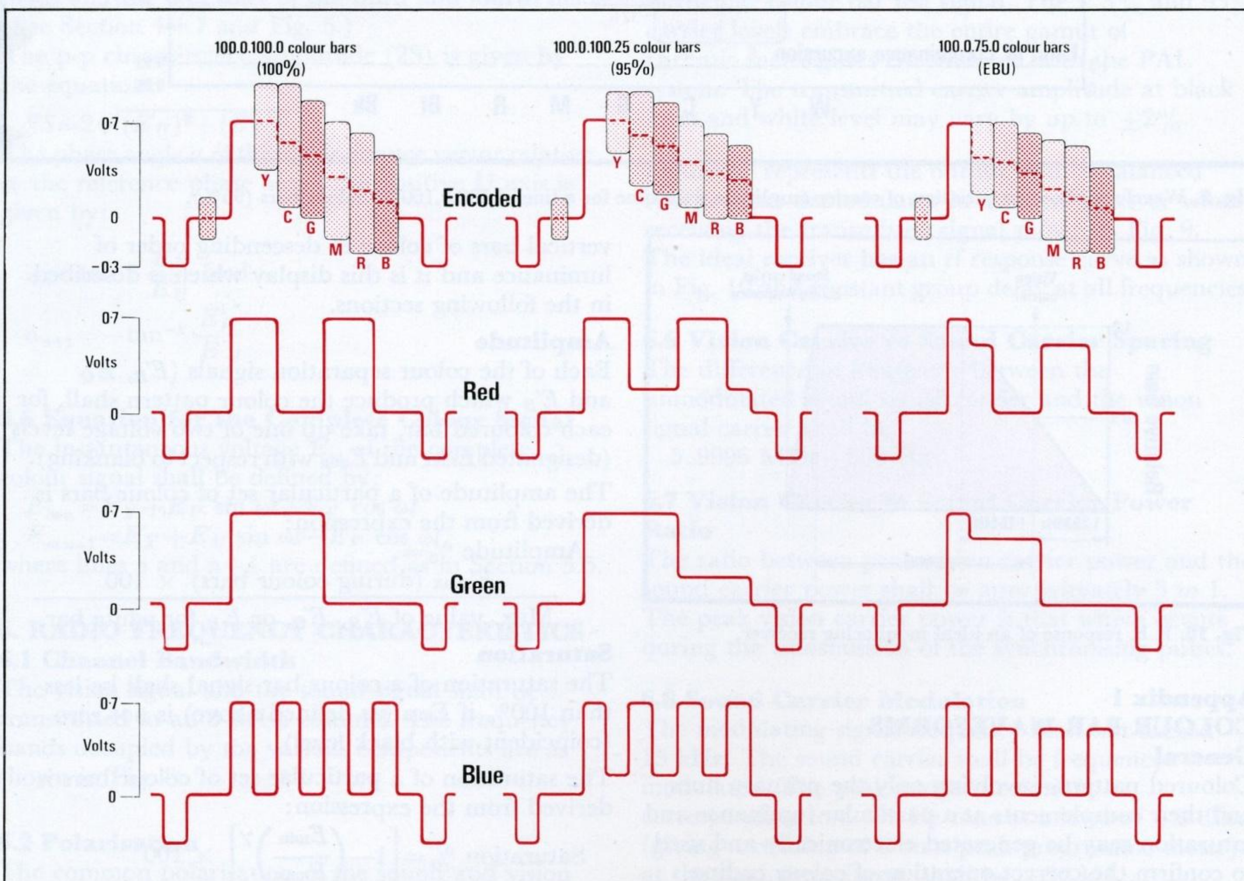


Fig. 11. The complete colour waveform and colour separation voltages for a scanning line of three common versions of luminance step colour bars.

specification and may, in some circumstances, be abbreviated by use of the last two figures *c* and *d* only.

Signal Parameters for Primary Colours and their Complements (*see section 5.5*)
Peak-to-peak amplitudes of chrominance components and peak luminance components are tabulated for colour bar signals with 0.7 V peak luminance. These amplitudes and phases are quoted for ideal signals, not subjected to any distortions. Line *n* refers to the odd lines of the first and second fields and the even lines of the third and fourth fields and line $n+1$ to the even lines of the first and second fields and the odd lines of the third and fourth fields. The specified chrominance angle is measured from the positive U axis as defined in Section 4.3.

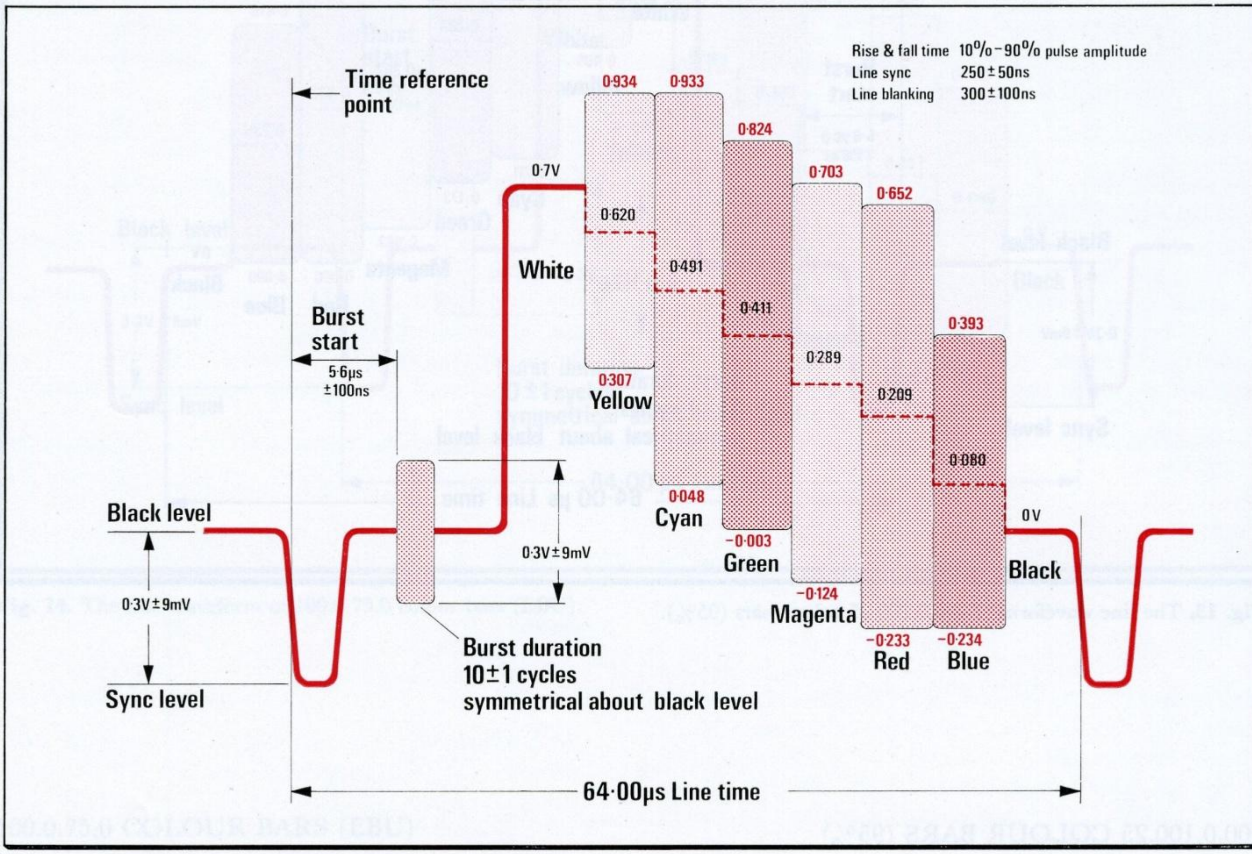


Fig. 12. The line waveform of 100.0.100.0 colour bars (100%).

100.0.100.0 COLOUR BARS (100%)

COLOUR	LUMINANCE E'_Y	PEAK-TO-PEAK CHROMINANCE U AXIS $2E'_U$	V AXIS $2E'_V$	TOTAL $2S$	CHROMINANCE ANGLE (α) IN DEGREES LINE n	LINE $n+1$
White	0.700	0	0	0	—	—
Yellow	0.620	0.612	0.140	0.627	167	193
Cyan	0.491	0.206	0.861	0.885	283.5	76.5
Green	0.411	0.405	0.721	0.827	240.5	119.5
Magenta	0.289	0.405	0.721	0.827	60.5	299.5
Red	0.209	0.206	0.861	0.885	103.5	256.5
Blue	0.080	0.612	0.140	0.627	347	13.0
Burst	0	0.212	0.212	0.300	135	225

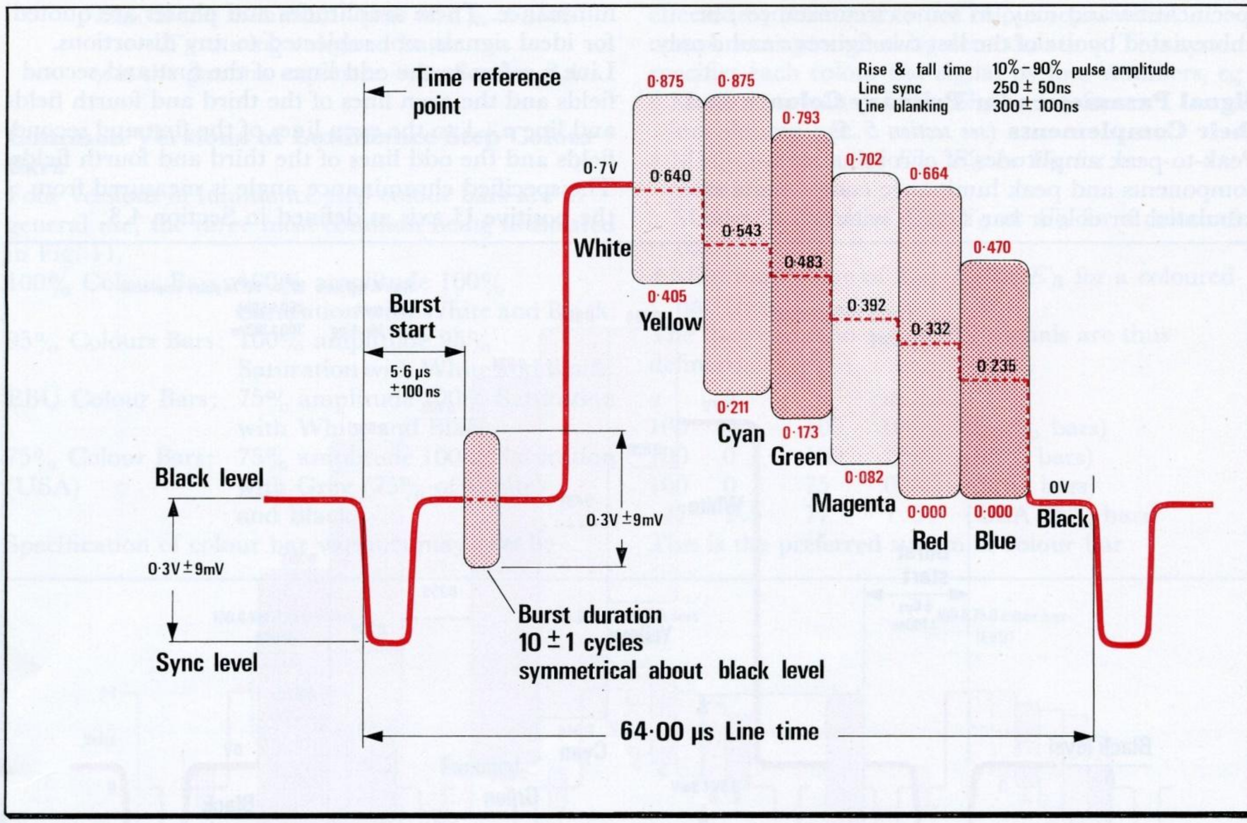


Fig. 13. The line waveform of 100.0.100.25 colour bars (95%).

100.0.100.25 COLOUR BARS (95%)

COLOUR	LUMINANCE E'_Y	PEAK-TO-PEAK CHROMINANCE U AXIS $2E'_U$	V AXIS $2E'_V$	TOTAL $2S$	CHROMINANCE ANGLE (α) IN DEGREES LINE n	LINE $n+1$
White	0.700	0	0	0	—	—
Yellow	0.640	0.459	0.105	0.470	167	193
Cyan	0.543	0.155	0.646	0.664	283.5	76.5
Green	0.483	0.304	0.541	0.620	240.5	119.5
Magenta	0.392	0.304	0.541	0.620	60.5	299.5
Red	0.332	0.155	0.646	0.664	103.5	256.5
Blue	0.235	0.459	0.105	0.470	347	13.0
Burst	0	0.212	0.212	0.300	135	225

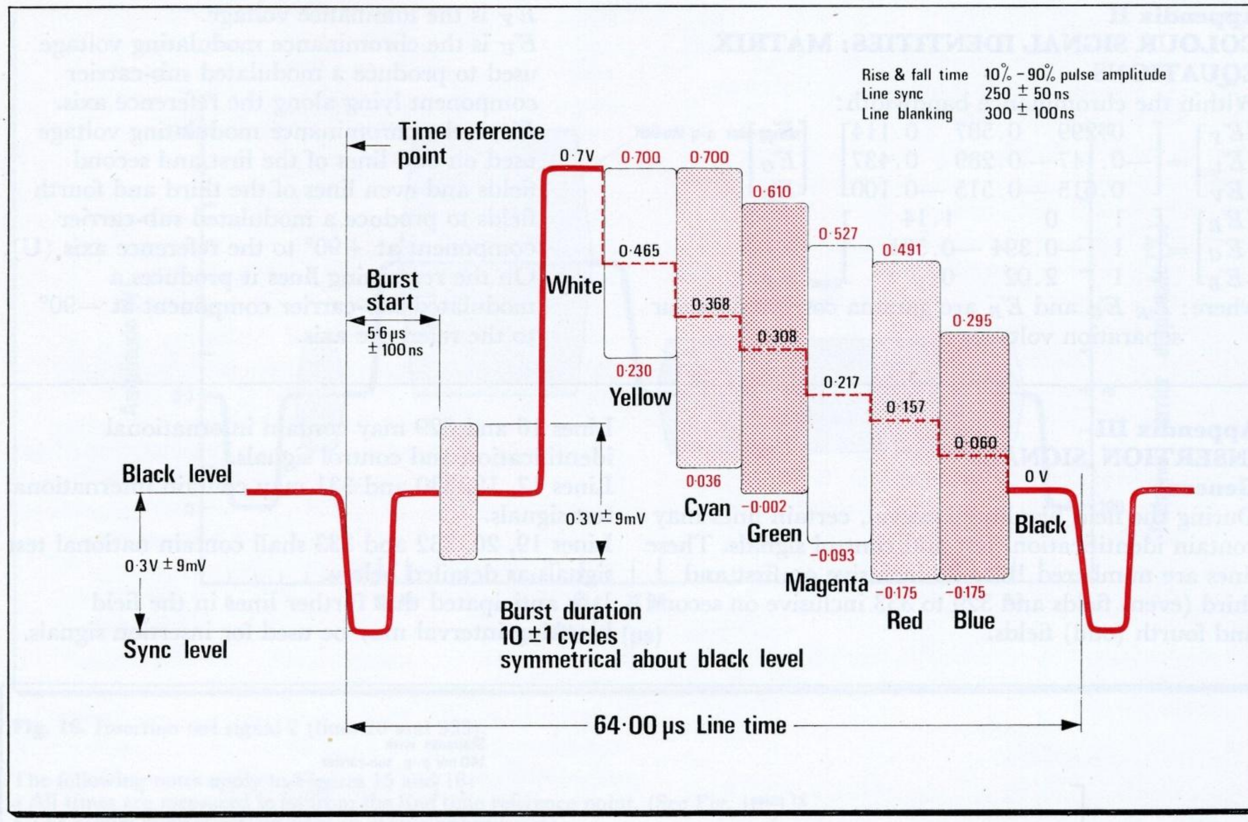


Fig. 14. The line waveform of 100.0.75.0 colour bars (EBU).

100.0.75.0 COLOUR BARS (EBU)

COLOUR	LUMINANCE E'_Y	PEAK-TO-PEAK CHROMINANCE U AXIS $2E'_U$	V AXIS $2E'_V$	TOTAL $2S$	CHROMINANCE ANGLE (α) IN DEGREES LINE n	LINE $n+1$
White	0.700	0	0	0	—	—
Yellow	0.465	0.459	0.105	0.470	167	193
Cyan	0.368	0.155	0.646	0.664	283.5	76.5
Green	0.308	0.304	0.541	0.620	240.5	119.5
Magenta	0.217	0.304	0.541	0.620	60.5	299.5
Red	0.157	0.155	0.646	0.664	103.5	256.5
Blue	0.060	0.459	0.105	0.470	347	13.0
Burst	0	0.212	0.212	0.300	135	225

Appendix II
COLOUR SIGNAL IDENTITIES: MATRIX EQUATIONS

Within the chrominance bandwidth:

$$\begin{bmatrix} E'_Y \\ E'_U \\ E'_V \end{bmatrix} = \begin{bmatrix} 0.299 & 0.587 & 0.114 \\ -0.147 & -0.289 & 0.437 \\ 0.615 & -0.515 & -0.100 \end{bmatrix} \begin{bmatrix} E'_R \\ E'_G \\ E'_B \end{bmatrix}$$

$$\begin{bmatrix} E'_R \\ E'_G \\ E'_B \end{bmatrix} = \begin{bmatrix} 1 & 0 & 1.14 \\ 1 & -0.394 & -0.581 \\ 1 & 2.02 & 0 \end{bmatrix} \begin{bmatrix} E'_Y \\ E'_U \\ E'_V \end{bmatrix}$$

where: E'_R E'_G and E'_B are gamma corrected colour separation voltages.

E'_Y is the luminance voltage.
E'_U is the chrominance modulating voltage used to produce a modulated sub-carrier component lying along the reference axis.
E'_V is the chrominance modulating voltage used on odd lines of the first and second fields and even lines of the third and fourth fields to produce a modulated sub-carrier component at $+90°$ to the reference axis (U). On the remaining lines it produces a modulated sub-carrier component at $-90°$ to the reference axis.

Appendix III
INSERTION SIGNALS
General

During the field blanking interval, certain lines may contain identification, test and control signals. These lines are numbered 16 to 20 inclusive on first and third (even) fields and 329 to 333 inclusive on second and fourth (odd) fields.

Lines 16 and 329 may contain international identification and control signals.

Lines 17, 18, 330 and 331 may contain international test signals.

Lines 19, 20, 332 and 333 shall contain national test signals as detailed below.

It is anticipated that further lines in the field blanking interval may be used for insertion signals.

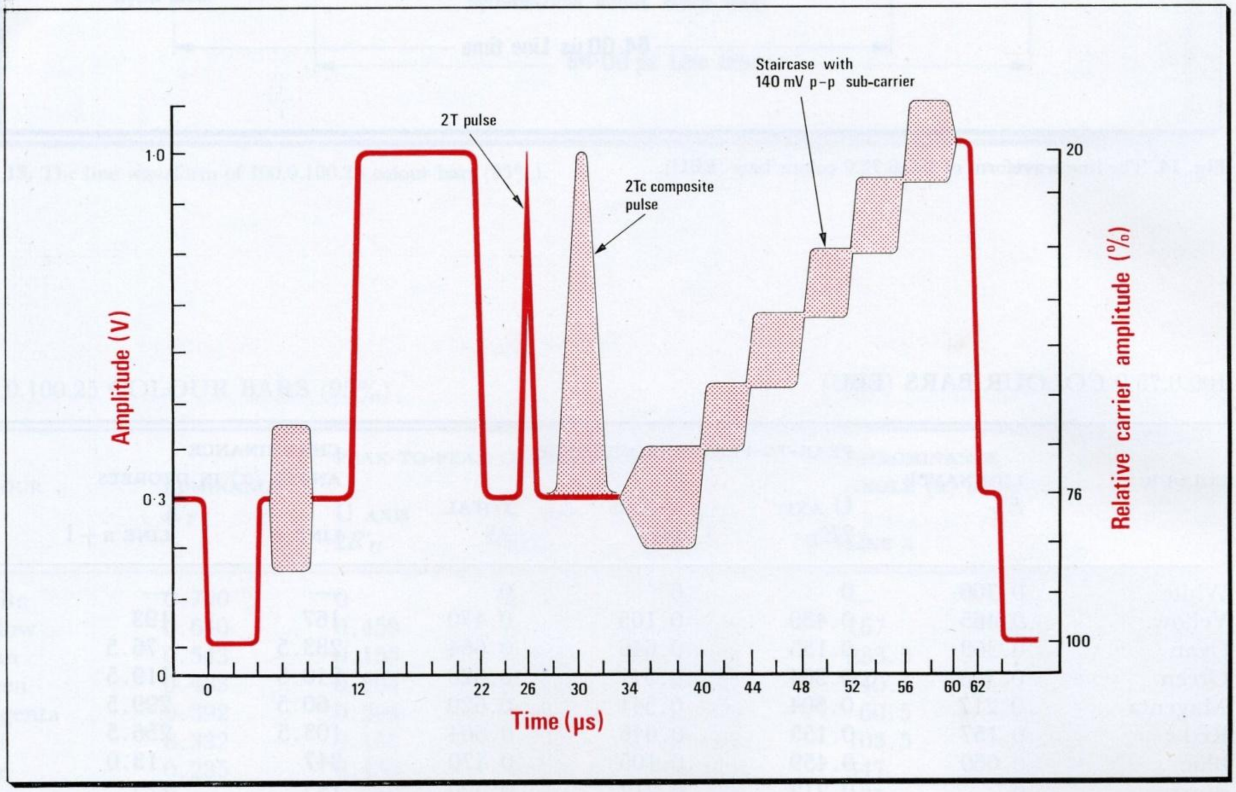


Fig. 15. Insertion test signal 1 (lines 19 and 332).

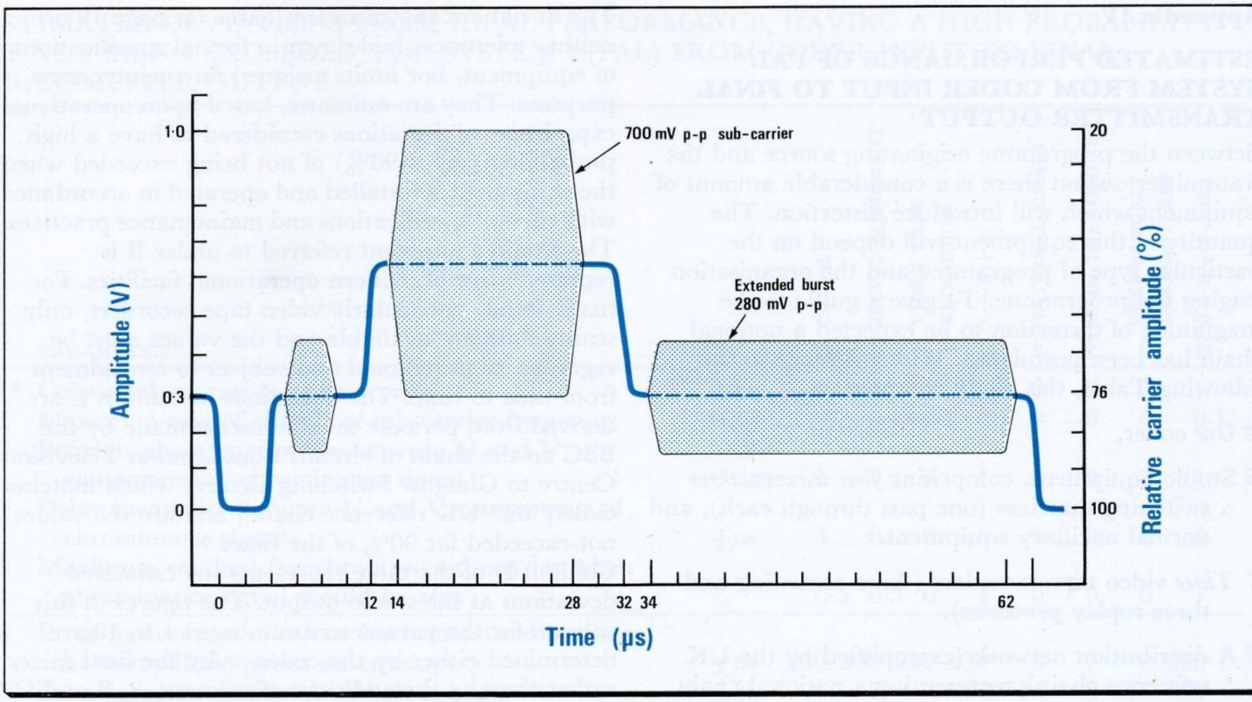


Fig. 16. Insertion test signal 2 (lines 20 and 333).

The following notes apply to Figures 15 and 16:
a All times are measured in µs from the line time reference point. (See Fig. 1.)
b The colour burst is present only on colour transmissions.
c The added sub-carrier is locked at a nominal angle of 60° to the U axis when the burst is present.

National Test Signals

The national test signals normally transmitted on lines 19, 20, 332 and 333 are detailed on Figs. 15 and 16.

These lines contain the necessary test waveforms to facilitate the measurement of transmission performance as specified in Appendix IV.

Insertion test signal 1, on lines 19 and 332, comprises a 10 µs white bar which may contain a full-amplitude 2T negative pulse, a full-amplitude 2T positive pulse, a composite pulse (10T) consisting of a half-amplitude luminance pulse with a full-amplitude chrominance pulse, and a five-riser staircase with an added 4.43 MHz sub-carrier at constant phase and amplitude. The p-p magnitude of this sub-carrier is 140 mV in a standard 700 mV p-p picture signal.

Insertion test signal 2, on lines 20 and 333, contains a half-amplitude luminance bar, part of which has full-amplitude 4.43 MHz sub-carrier superimposed, and an extended burst of sub-carrier covering the second half of the scanning line.

The 2T pulse and 10µs bar on test signal 1 enable the K rating to be obtained, while measurement of line-time nonlinearity may be made by passing the staircase waveform through a filter of restricted bandwidth. The 10T composite pulse permits assessment of chrominance-luminance gain and delay inequalities.

Chrominance-luminance crosstalk can be measured from the bar waveform on test signal 2. The extended burst on test signal 2 is of constant phase and amplitude and is intended for demodulating the sub-carrier on the previous line in order to measure the differential phase.

Appendix IV

ESTIMATED PERFORMANCE OF PAL SYSTEM FROM CODER INPUT TO FINAL TRANSMITTER OUTPUT

Between the programme originating source and the transmitter output there is a considerable amount of equipment which will introduce distortion. The quantity of this equipment will depend on the particular type of programme and the organisation staging the programme. To give a guide to the magnitude of distortion to be expected a notional chain has been postulated. With reference to the following Table, this chain comprises:

A One coder.

B Studio equipment, comprising *four* mixers, *three* switching matrices (one pass through each), and normal ancillary equipment.

C Three video tape recorders (three recording and three replay processes).

E A distribution network (exemplified by the UK reference chain) representing a national chain of circuits.

F One main transmitter.

G Two rebroadcast transmitters with associated rebroadcast receiving equipment (involving two demodulations to video baseband).

The deviations shown in the Table on page 19 are neither tolerances laid down in formal specifications of equipment, nor limits assigned for maintenance purposes. They are estimates, based upon operational experience, of deviations considered to have a high probability (say >90%) of not being exceeded when the equipment is installed and operated in accordance with current specifications and maintenance practices. The studio equipment referred to under B is representative of modern operational facilities. For many items, particularly video tape recorders, only scanty data are available and the values must be regarded as provisional and subject to amendment from time to time. The deviations in column E are derived from periodic measurements made by the BBC on the chain of circuits from London Television Centre to Glasgow Switching Centre, which matches closely the 'UK reference chain', and are the values not exceeded for 90% of the time.
Column D of the table represents the estimated deviations at the studio output. The figures in this column for the parameters numbered 1 to 10 are determined either by the coder or by the final mixer rather than by the additions of columns A, B and C. In all other cases, the additions given in columns D and H were made on a power-law basis in accordance with CCIR Recommendation 451, annex to Part 1. In the absence of specific guidance from this source, the exponent h was taken to be $\frac{3}{2}$ for the parameters numbered 11, 12 and 17.

ESTIMATED DEVIATIONS FROM IDEAL PERFORMANCE, HAVING A HIGH PROBABILITY OF NOT BEING EXCEEDED, FOR SYSTEM I (PAL) FROM CODER INPUT TO FINAL TRANSMITTER OUTPUT

PARAMETER NO.	PARAMETER		CODER A	STUDIO EQUIPMENT B	VIDEO TAPE RECORDERS C	A+B+C D	NATIONAL CHAIN E	MAIN TRANSMITTER F	REBROADCAST TRANSMITTERS G	D+E+F+G H
1*	Colour sub-carrier frequency error	±Hz	1	1	1	1	0	0	0	1
2	Maximum rate of change of sub-carrier frequency	Hz/s	0·1	0·1	0·1	0·1	0	0	0	0·1
3	Error in phase quadrature between U and V components of chrominance signal	±deg	1	0	0	1	0	0	0	1
4	Delay inequality between U and V components of chrominance signal	±ns	5	0	0	5	0	0	0	5
5	Maximum residual (synchronous) sub-carrier when chrominance signal should be zero	%	0·5	0·5	0	1	0	0	0	1
6	Error in duration of colour burst measured between half-amplitude points on envelope	±ns	230	230	230	230	0	0	0	230
7*	Error in mean amplitude of colour bursts	±%	1	3		3	14	8	14	22
8	Difference in amplitudes of bursts on successive lines	%	5	5		5	0	0	0	5
9*	Error in start of colour burst, measured between half-amplitude points of leading edge of sync and leading edge of burst envelope	±ns	100	100		100	40	35	55	126
10	Errors in phase angles between individual bursts and the mean burst phase	±deg	0·5	0·5		0·5	0	0	0	0·5
11	Chrominance signal phase errors with respect to mean phase of the bursts, independent of luminance signal magnitude and chrominance quadrature errors and measured near to or at blanking level	±deg	0·5	2	2	2	0	2	3	5
12	Error in the ratio between the amplitude of the colour burst and that of the chrominance signal	±%	1	7	6	11	0	5	10	18
13	Random noise, unweighted	dB	70	55	38	38	49	60	40	36
14	Non-linearity, luminance	%		4	12	14	6	8	13	27
15	Differential gain	±%	0	6	10	13	8	6·5	13	26
16	Differential phase	±deg	0	6	8	11	8	6·5	13	25
17	Chrominance-luminance crosstalk	±%	0	2	4	5	9	4	13	21
18	K (bar)	%	0·5	2	3	4	3·5	1·5	5	9
19	K (2T pulse)	%	0·5	2	3	4	2·5	3	7	11
20*	K (2T pulse/bar ratio)	%	0·5	2	3	4	2·5	2	4	8
21*	Gain inequality	±%	2	6	10	12	14	8	14	24
22	Delay inequality	±ns	5	50	60	78	40	35	55	109

***Notes:** 1. Where the signal originates from an overseas source, this error may be increased to ±5 Hz.
7. This error is modified by gain inequalities as the signal passes from studio output to final transmitter.
9. This error is modified by delay inequalities as the signal passes from studio output to final transmitter.
20, 21. Limiters at transmitters prevent the picture luminance signal (below 1 MHz) from exceeding its nominal amplitude by more than 5–10%.

Code of Practice for Television Studio Centre Performance

Synopsis

Under the Independent Broadcasting Authority, the IBA is responsible for the maintenance of high technical standards throughout the Independent Television network, including studio centres (although these are owned and operated by the various programme companies), transmitting stations and networks links including outside broadcast equipment.

For this reason, the IBA Quality Control Section, in consultation with the programme companies and other IBA engineering departments, has drawn up detailed Codes of Practice for television studio centres, transmitting stations and outside broadcast equipment, as key elements in its technical quality control system. These Codes of Practice now play an important role in the planning, equipping and operation of all Independent Television studio and transmitting centres, and lay down tolerance limits and operational standards to be observed. The Codes specify limits to be realised on a day-to-day basis, and provide a set of performance targets for the operations engineer.

Tolerances are related to complete signal paths and do not provide an equipment specification. Working parties exist within the IBA to maintain a continuous review of the Codes.

Section 1
DEFINITIONS AND OPERATIONAL PRACTICES

1.1 General

For clarity, explanatory information concerning the individual tests has been included in the form of reference footnotes. Where necessary, titles of individual tests have been changed to conform to CCIR recommendations, and day-to-day operation should aim at achieving performance within the tolerances quoted.

1.2 Direct Path

For purposes of measurement the direct path is assumed to comprise the circuit from the Post Office Terminal equipment through the presentation switching and processing equipment, back to the Post Office Terminal equipment.

1.3 Worst Path

These tolerances should not be exceeded during any normal programme transmission.

For the purposes of routine measurement, the worst path is assumed to comprise the following, with all interconnections carried out using the normal assignment routes:

i The source studio mixer;
ii a looped VTR path;
iii a second studio mixer (to simulate VTR insert conditions);
iv a second looped VTR path;
v the presentation and master control switcher.

The tolerance limits do not include degradations due to signal sources (camera, telecines, etc.) or video tape recorders, as tolerances for these are separately specified.

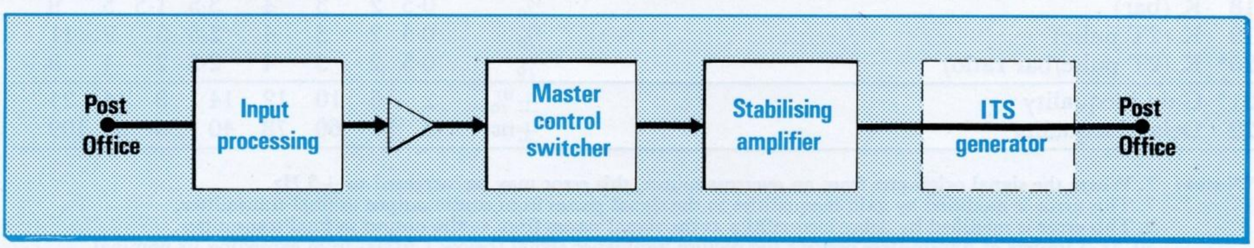


Fig. 1. A typical direct path.

1.4 Video Tape Recorder Tolerances

The tolerances for video tape recorders, listed in Sections 2 and 4, refer to a single recording with replay either on the same machine or on another machine of the same type.

1.5 Test Method

Unless otherwise stated in the Code, measurement methods should comply with IBA recommendations based, where appropriate, on CCIR recommendation 451.

1.6 Adjustment of Video Signal Levels

a Video signal levels (picture white, black etc.) are adjusted at the originating studio before insertion test signals are added to the composite signal. Except at this point, or at subsequent points where picture fade facilities are essential, only the overall level of the composite signal should be adjusted.

b The ratio between the sub-carrier burst and the chrominance signal should not be changed at an intermediate studio.

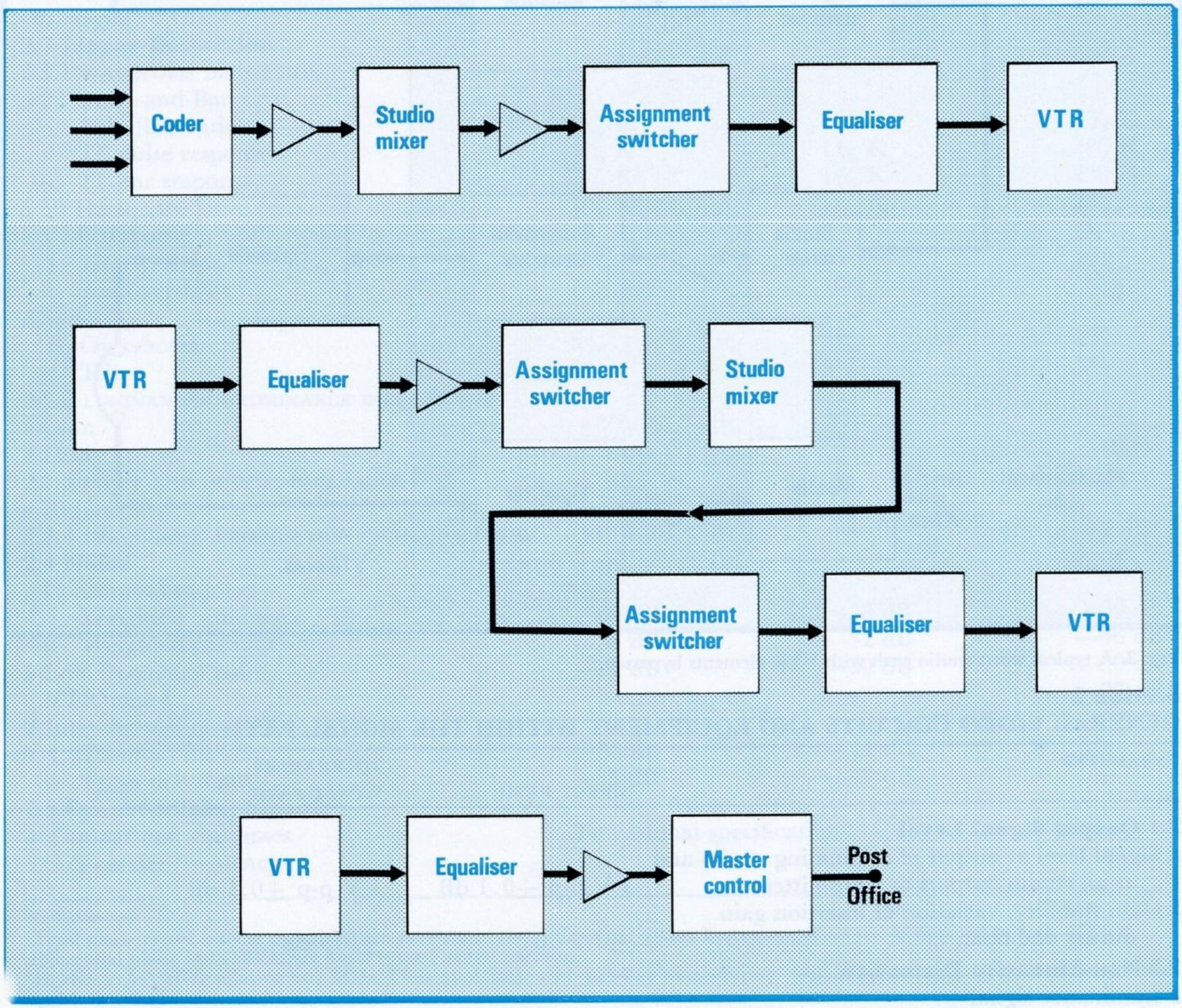


Fig. 2. Separate elements of a typical worst studio path, showing routes for recording, compilation and transmission.

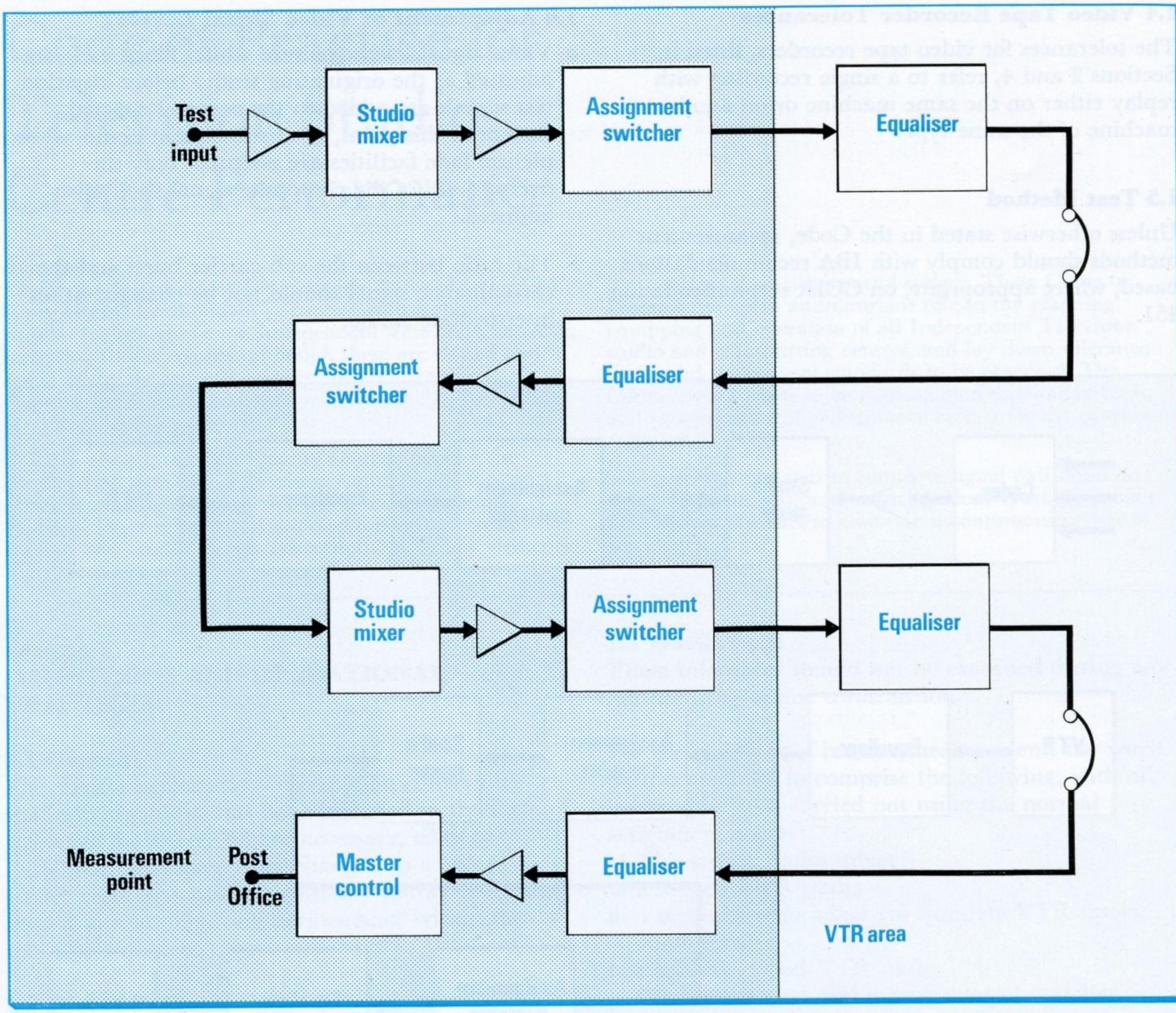


Fig. 3. A typical worst studio path with VTR elements bypassed.

Section 2
GENERAL VIDEO CIRCUITS AND EQUIPMENT WITHIN THE SIGNAL PATH

PARAMETER	TOLERANCES DIRECT PATH	WORST PATH	VTR
2.1 Output Signal Level			
a Signal level at output of originating studio and at all studio outputs to transmitters	1 V p-p ±0.1 dB	1 V p-p ±0.1 dB	—
b Gain stability, variation of insertion gain during one hour	±0.2 dB	±0.5 dB	—
2.2 Non-Linearity Distortion			
a Luminance signal			
i Line time non-linearity	3%	5%	10%

PARAMETER	TOLERANCES DIRECT PATH	TOLERANCES WORST PATH	TOLERANCES VTR
b Chrominance signal			
i Total phase errors[1]	±2°	±5°	±6°
ii Differential gain	±3%	±5%	±7%
c Dynamic gain			
i Luminance	±1%	±2%	±1%
ii Chrominance	±1%	±2%	±1%
iii Sync	±1%	±2%	±1%
d Transient crushing			
i Luminance	2%	5%	2%
ii Chrominance	2%	5%	2%
iii Sync	2%	5%	2%
2.3 Linear Distortion			
2.3.1 WAVEFORM DISTORTION			
a 2T Pulse-and-Bar			
i Pulse/bar ratio	½% K	1% K	2% K
ii 2T pulse response	½% K	1% K	2% K
iii 2T bar response	½% K	1% K	2% K
b 50 Hz square wave response	½% K	1% K	2% K
c VLF response			
i 1st overshoot	14%	25%	—
ii 2nd overshoot	7%	10%	—
d Sync			
i Overshoots	5%	5%	5%
ii Tilt	5%	5%	5%
2.3.2 LUMINANCE-CHROMINANCE INEQUALITIES			
a Gain	±3%	±4%	±6%
b Delay	±20 ns	±40 ns	±40 ns
2.3.3 INPUT AND OUTPUT IMPEDANCE			
a Return loss	30 dB	—	—
2.3.4 FREQUENCY ATTENUATION CHARACTERISTIC[2]	±0.5 dB	±1 dB	±2 dB
2.4 Noise			
a Continuous random			
i Weighted luminance	—64 dB	—58 dB	—50 dB
ii Weighted chrominance	—58 dB	—52 dB	—46 dB
b Low frequency noise	—52 dB	—50 dB	—50 dB
c VTR moiré	—	—	—22 dB
d Interchannel crosstalk			
i From all inputs	—50 dB	—44 dB	—
ii From one input	—55 dB	—49 dB	—
2.5 Synchronising Signals[3]			
a Timings and rise times	To national specifications		
b Sub-carrier frequency			

References

[1]Total phase errors are the combined errors of static and differential phase. Errors are measured as detailed in Rec. 451 for differential phase but sub-carrier burst is used as the reference.

[2]10 kHz to 5·5 MHz relative to 1 MHz. Only applicable with 625-line monochrome systems (where chrominance pulse-and-bar signals are not in use).

[3]See *Specification of Television Standards for 625-line System I Transmissions.*

Section 3
VIDEO SIGNAL SOURCES

It is recommended that the overall colour analysis characteristic of all picture sources should be optimum for a typical set of currently used display phosphors and a receiver white point of illuminant D (6500°K).

The CIE co-ordinates of the display phosphors are assumed to be:

	CIE (1931) x	y	CIE (UCS) (1960) u	v
Red	0.64	0.33	0.451	0.349
Green	0.29	0.60	0.121	0.374
Blue	0.15	0.06	0.175	0.105

The above co-ordinates have been chosen as representing the phosphors likely to be used in shadow mask display tubes fitted to receivers manufactured in the United Kingdom. The co-ordinates are different from those of the original NTSC specification since the latter are no longer of practical significance. However, no alteration of the signal coding has been made to take account of the revised phosphor characteristics used and hence the new co-ordinates are used only in the computation of the colour-analysis characteristics of picture origination equipment. In the event of a new phosphor becoming available and achieving wide popularity because of superior performance, it is expected that the analysis characteristics used in the picture originating sources would be changed to suit the new situation as opportunities arose. It is thought to be unlikely that any changes in display phosphors would be of such a magnitude that the use of new colour analysis characteristics in the picture originating equipment would place other receivers, not having the latest display phosphors, at any serious disadvantage.

The tolerances in this section are related to general purpose studio and OB cameras, telecine and slide scanners. Equipments for specific purposes, such as presentation cameras and clock scanners, are required to meet a subjective performance limit of Grade 2 or better.

For the following tests, cameras should initially be set up and correctly exposed as for normal studio use. The test chart or slide should produce the same peak illumination at the same colour temperature as would be produced by a 60% reflectance neutral surface under normal studio lighting at the same lens aperture. Aperture correction should be adjusted so that a black and white square wave pattern equivalent to 400 lines per picture height gives a p-p amplitude equal to that of a black to white transition at the centre of the field. Gamma correction should be set to 0.45.

Telecine machines should initially be set up using a suitable test film. Aperture correction for 35 mm and slide reproduction should be adjusted as for cameras; for 16 mm reproduction the correction should be adjusted to give the same response for 300 lines as for a black to white transition. Afterglow correction (where appropriate) should be adjusted for optimum response. Gain or light control (whichever is appropriate) should be adjusted to achieve a standard picture level of 0.7 V p-p using a neutral filter of density 0.35. Gamma correction should be within the range 0.25 to 0.4.

3.1 Gain Stability

Variation in output levels during one hour ±0.2 dB

3.2 Black Shading[4]

a Each channel	2%
b Differences between RGB channels	½%

	EACH CHANNEL	DIFFERENCE BETWEEN CHANNELS
3.3 White Shading[4]		
a Plumbicon cameras and scanners		
Zone A, an ellipse touching all four sides of the picture area	8%	5%
Whole field	20%	10%
b Flying-spot scanners		
Zone A, an ellipse touching all four sides of the picture area	4%	3%
Whole field	10%	5%

3.4 Resolution[5]

a Image orthicon camera

At centre	±1 dB wrt black/white transition
In corner	—3 dB wrt centre

b Photo-conductive camera and photo-conductive telecine

At centre	±1 dB wrt black/white transition
In corner	—4 dB wrt centre

c Flying-spot telecine

At centre	±1 dB wrt black/white transition
In corner	—3 dB wrt centre

3.5 Geometric Errors[6]

Zone A, an ellipse touching all four sides of the picture area	±1%
Zone B, the remainder of the picture area	±2%

3.6 Registration[6]

Zone A, an ellipse touching all four sides of the picture area	0.1%
Zone B, the remainder of the picture area	0.4%

3.7 Positional Hum

a Each channel	0.05%
b Differences between RGB channels	Negligible

3.8 Latent and Other Spurious Images

Not worse than severity Grade 2 on the subjective impairment scale.

3.9 Line Streaking[7]

a Each channel	1%
b Differences between RGB channels	Negligible

3.10 Noise[8]	LUMINANCE WEIGHTED	CHROMINANCE WEIGHTED	LOW FREQUENCY
a Cameras*	—48 dB	—39 dB	—50 dB
b 35 mm and slide flying-spot scanners	—51 dB	—45 dB	—50 dB
c 16 mm flying-spot scanners	—48 dB	—42 dB	—50 dB
d 35 mm photo-conductive scanners	—50 dB	—44 dB	—50 dB
e 16 mm photo-conductive scanners	—47 dB	—41 dB	—50 dB

* *These figures relate to equipment currently in use. New camera channels would reasonably be expected to conform with more stringent performance standards of —53 dB luminance weighted noise and —44 dB chrominance weighted noise.*

References

[4]Shading is taken as the peak-to-peak departure from a uniform field.

[5]Resolution should be measured on the coder output.

[6]Displacement expressed as a percentage of picture width.

[7]A streaking chart, slide, or test film should be used consisting of separated white horizontal bands of different lengths on a black ground. The streaking is taken as the maximum disturbance to the black ground on a strobed line through a band compared with a strobed line immediately below the band and expressed as a percentage of the white signal amplitude.

[8]Noise levels on cameras should be measured at the coder output using a plain neutral card of reflectance 14% or a neutral slide producing the same luminance. On telecine and slide scanners, a test film or slide of neutral density 1.07 should be used. For chrominance weighted measurement the coder balance should be checked to ensure that residual sub-carrier is not significant. Subsequently the camera channel balance controls should be adjusted to optimise the noise reading obtained.

Section 4
SOUND CIRCUITS AND EQUIPMENT

PARAMETER	TOLERANCES DIRECT PATH	WORST PATH	VTR†
4.1 Insertion Gain[9]			
a Adjustment error	±0.25 dB	±0.5 dB	±0.5 dB
b Medium term stability	±0.25 dB	±0.5 dB	±0.5 dB
4.2 Non-Linear Distortion[11]			
Harmonic factor			
i 1kHz, —10 dBm	0.5%	0.5%	1.0%
ii 1kHz, 0 dBm	0.5%	0.5%	1.0%
iii 1kHz, +8 dBm	0.5%	1.0%	2.0%
iv 80 Hz, —10 dBm	0.5%	1.0%	2.0%
v 80 Hz, 0 dBm	0.5%	1.0%	2.0%
vi 80 Hz, + 8 dBm	1.0%	2.0%	3.0%
4.3 Amplitude-Frequency Response[10]			
a 40 Hz to 15 kHz	$^{+1}_{-2}$ dB	$^{+1}_{-3}$ dB	$^{+1}_{-3}$ dB or ±2 dB
b 125 Hz to 10 kHz	±1 dB	$^{+1}_{-2}$ dB	±1 dB
4.4 Noise[11]			
Wideband noise	—60 dB	—35 dB	—35 dB
4.5 Crosstalk[12]			
Interchannel crosstalk	—45 dB	—40 dB	—
4.6 Wow and Flutter[13]	—	—	0.15%

References

[9]*a* The difference between input and output levels of any unity gain path, after adjustment of the complex, measured with an input level of —10 dBm.
b Change in output level over a period of one hour with the input level constant at —10 dBm.

[10]Measured at a level of —10 dBm, with 1 kHz as the reference frequency. The test should be carried out using the following frequencies:
40, 60, 125, 250, 500 Hz.
1, 2, 4, 6, 8, 10, 12, 14, 15 kHz.

[11]Noise and Distortion:
a DIRECT PATH. Line-up should be carried out with 1 kHz tone at zero dBm fed to the channel under test, using channel faders and gain controls in the normal manner to achieve zero dBm at the station output. Distortion should be measured under these conditions. A CCIR weighting network (as defined in Ref. 468, Vol. V, Pt. 1, New Delhi, 1970) should then be interposed between the station output and a noise meter which incorporates a standard PPM. Noise should then be measured with the input terminated.
b WORST PATH. Line-up should be carried out with 1 kHz tone at —70 dBm fed to the appropriate studio floor inlet using channel faders and amplifier gain controls in the normal manner to achieve zero dBm at the station output. Distortion measurements should be made under these conditions. A CCIR weighting network (as defined in Ref. 468, Vol. V, Pt. 1, New Delhi, 1970) should then be interposed between the station output and a noise meter which incorporates a standard PPM. Noise should then be measured under these conditions.
c MAGNETIC RECORDERS AND REPRODUCERS. Line-up for noise measurement should be carried out using a standard reference tape appropriate to the equipment. The recorded tone should be followed by a period of recording with channel inputs terminated. Noise line-up on play-back should include the CCIR weighting network.

[12]Measurements should be made as for wide-band noise with the test circuit input terminated and standard level tone fed to any other input at 40 Hz, 250 Hz, 1 kHz, 6 kHz, 12 kHz and 15 kHz. The crosstalk performance will be taken as the highest output level.

[13]Measured at a test frequency of 3.15 kHz. Wow and flutter frequencies in the range 200 mHz to 200 Hz should be measured peak weighted using a weighting network and measuring equipment which comply with CCIR Rec. 409–2.

†The tolerances in the column 'Magnetic Recorders and Reproducers' apply to all equipments in the main programme chain. For subsidiary equipments, such as effects recorders, a limit of subjective Grade 2 should apply.

Code of Practice for the Technical Performance of Television Outside Broadcast Equipment

Synopsis
This Code of Practice provides performance limits for the vision and sound signal paths associated with Outside Broadcasts in Independent Television.

Section 1
EXPLANATORY NOTES

1.1 Signal Paths

Two sets of performance limits are provided for each of the vision and sound signal paths. These are headed 'OB Scanner Tolerances' and 'OB Link Tolerances'. Performance of origination equipment is not included since this should normally comply with the standards laid down in Section 3 of the Authority's Code of Practice for Television Studio Centre Performance. However, a working party is considering the possibility that the Code should include a reference to the permissible use of cameras having a slightly relaxed performance for certain specialised applications.

The OB scanner tolerances relate to the circuits from the colour coder output (or CCU output in the case of monochrome units), and audio mixer input to the OB link inputs. This circuit will include all mixing, switching and processing equipment normally in use in programme operation.

The OB link tolerances are related to an unspecified number of point-to-point shf links. They include all equipment between the mobile control room output and the injection point (either the controlling studio input or a PO switching centre).

1.2 Test Methods

Unless otherwise stated in the Code, measurement methods should comply with IBA recommendations based, where appropriate, on CCIR Recommendation 451.

Section 2
VIDEO PERFORMANCE LIMITS

PARAMETER	OB SCANNER TOLERANCES	OB LINK TOLERANCES
2.1 Output Signal Level		
a Signal level at output of scanner and at injection point after line-up	1V p-p±0.1 dB	1V p-p±0.25 dB
b Gain stability, variation of insertion gain during one hour	±0.2 dB	±0.25 dB
2.2 Non-Linearity Distortion		
a Luminance signal		
i Line-time non-linearity	3%	5%
ii Chrominance-luminance crosstalk	—	±3%

PARAMETER	OB SCANNER TOLERANCES	OB LINK TOLERANCES
b Chrominance signal		
i Total phase errors[14]	±2°	±5°
ii Differential gain	±3%	±5%
c Dynamic gain		
i Luminance	±3%	±3%
ii Chrominance	±3%	±3%
iii Sync	±3%	±3%
d Transient non-linearity		
i Luminance	3%	5%
ii Chrominance	3%	5%
iii Sync	3%	5%
2.3 Linear Distortion		
2.3.1 WAVEFORM DISTORTION		
a 2T Pulse-and-Bar		
i Pulse/bar ratio	$\frac{1}{2}$% K	2% K
ii Pulse response	$\frac{1}{2}$% K	2% K
iii Bar response	$\frac{1}{2}$% K	2% K
b 50 Hz square wave response	$\frac{1}{2}$% K	2% K
c VLF response		
i 1st overshoot	14%	14%
ii 2nd overshoot	7%	7%
d Sync		
i Overshoots	5%	5%
ii Tilt	5%	5%
2.3.2 LUMINANCE-CHROMINANCE INEQUALITIES		
a Gain	±3%	±4%
b Delay	±20 ns	±20 ns
2.3.3 OUTPUT IMPEDANCE		
a Return loss. OB link output at injection point	—	−30 dB
2.3.4 FREQUENCY ATTENUATION CHARACTERISTIC[15]	±0.5 dB	±1.0 dB
2.4 Noise		
a Continuous random		
i Weighted luminance	−64 dB	−55 dB
ii Weighted chrominance	−58 dB	−52 dB
b Periodic noise (other than sound-vision crosstalk)	−60 dB	−52 dB
c LF noise	−52 dB	−40 dB
d Interchannel crosstalk	−55 dB	
2.5 Modulation Derived Distortion		
a Sound-vision crosstalk		
i Sound sub-carrier modulated		−52 dB
ii Sound sub-carrier unmodulated (level of intermodulation product between sound and chrominance sub-carriers)	—	−47 dB

References

[14]Total phase errors are the combined errors of static and differential phase.

[15]Level from 10 kHz to 5.5 MHz, relative to that at 1 MHz. Only applicable with 625-line monochrome systems.

Section 3
AUDIO PERFORMANCE LIMITS

PARAMETER	OB SCANNER TOLERANCES	OB LINK TOLERANCES
3.1 Output Signal Level		
a Signal level at output of scanner and at injection point after line-up	0 dBm ±0.25 dB	0 dBm ±0.25 dB
b Gain stability, variation of insertion gain during one hour	±0.25 dB	±0.25 dB
3.2 Harmonic Distortion[16]		
a 1 kHz at reference level input	0.3%	0.5%
b 80 Hz at reference level input	0.5%	0.5%
c 1 kHz at +8 dB wrt ref.	0.5%	1%
d 80 Hz at +8 dB wrt ref.	1%	1%
3.3 Frequency Attenuation Characteristic		
a 40 Hz to 15 kHz wrt kHz	$^{+1}_{-2}$ dB	$^{+0.5}_{-2.5}$ dB
b 60 Hz to 12 kHz wrt 1 kHz	+1 dB	$^{+0.5}_{-1.5}$ dB
3.4 Noise[16]		
a Continuous, random, weighted	−55 dB	−50 dB
b Single-frequency, periodic, weighted	−65 dB	−60 dB
c Interchannel crosstalk, weighted[17]	−55 dB	
3.5 Modulation Derived Distortion		
a Vision-sound crosstalk, weighted[18]		−50 dB

References

[16]*a* SCANNER Line-up carried out with 1 kHz tone, at −70 dBm, fed to channel under test, using faders and amplifier gain controls in the normal manner to achieve 0 dBm, at the link input. Distortion is then measured. CCIR weighting network is then included and channel again lined up to achieve zero dBm input to link. Noise measured with channel input terminated.

b LINK Methods as above, using 0 dBm input level to link and vision channel unmodulated.

[17]Measured on scanner only. Line-up as for noise. Measurements made with input terminated and −70 dBm tone fed to any other input at 30 Hz, 200 Hz, 1kHz, 5 kHz, and 15 kHz.

[18]Measured on links only, with vision channel modulated in turn by a 50Hz, square wave, 100% colour bars and a five-step staircase waveform with 140 mV sub-carrier on all lines.

Code of Practice for the Technical Performance of Television Transmitting Stations

Synopsis
This Code of Practice provides performance limits for vision and sound signal paths at the different types of IBA vhf and uhf transmitting installations.

Section 1
EXPLANATORY NOTES

1.1 Introduction

The tolerances quoted should be aimed for on a day-to-day basis. They are, in general, less stringent than re-alignment tolerances, which are based upon equipment specifications.

1.2 Signal Paths

Each set of performance limits is related to a signal path which must incorporate all the equipment normally included in the chain of transmission.

The test signals (at a level of 1.0 V p-p video and 0 dBm audio) will always be inserted at the main station input in the Lines Termination Room. The video path will include a normal programme chain (plus insertion test signal path where appropriate), together with filters, shf or video link, correctors and any associated equipment.

Transmitter output should be measured at a combined, directional feeder monitoring point with the normal aerial system in use. Ideally, the outputs from forward couplers on each of the two main aerial feeders (before the two- or four-channel combining units on uhf installations) should be combined by a suitable resistive network.

Secondary main uhf stations with rbr feed and all transposers should be tested using signals inserted at the main station input, as described above. Main vhf station installations will include a 625-line/405-line standards converter in the video signal path.

1.3 Test Methods

Unless otherwise stated in the code, measurement methods should comply with IBA Recommendations which are based, where appropriate, on CCIR Recommendation 451.

1.4 Demodulators and Oscilloscopes

All measurements should be made using the appropriate IBA demodulator, unless otherwise stated. The video performance of the demodulator should first be ascertained by means of the built-in test transmitter. Any distortions attributable to the demodulator should be taken into account when transmitter performance is measured.

At the present time, some IBA demodulators use envelope detection and additional video distortion is thereby introduced.

Since uhf transmitters employ negative modulation, the quadrature distortion gives rise to out-of-band harmonics. A phase-linear 5.8 MHz low-pass filter must be used, therefore, between the demodulator video output and the measuring oscilloscope. The remaining distortions, attributable to the use of envelope detection with vsb transmission, are accurately known. Appropriate allowances should be made in accordance with the figures quoted in the relevant Sections. K rating

assessments on uhf installations should be made using a standard graticule.

The quadrature distortion experienced with positive-going pulses on vhf transmitters, using positive modulation, gives rise to frequency components which are mainly in the video band. The effects of such distortion on the pulse waveform must be taken into account by the use of Kv graticule, designed for the purpose.

Oscilloscopes should be accurately set up before use, by means of a standard gain calibrator. An oscilloscope equaliser should be used, if necessary, to obtain unity chrominance/luminance ratio.

The allowances to be made for envelope detection will no longer be relevant when synchronous demodulators are introduced. At the same time, the performance of rbr installations will be improved. The Code will be re-issued when these demodulators become available.

All uhf sound transmitter and transposer measurements should be carried out with the 50μs de-emphasis network in circuit.

Section 2
UHF INSTALLATIONS

PARAMETER	MAIN STATION	MAIN STATION RBR FED	TRANSPOSER FROM STATION	TRANSPOSER FROM RBR STATION
2.1 Video Performance				
2.1.1 TRANSMITTER MODULATION DEPTH				
a Level[19]				
i White level	20%±2%	20%±2%	20%±2%	20%±2%
ii Blanking level	76%±2%	76%±2%	76%±2%	76%±2%
b Gain stability, variation of modulation depth at white level and at blanking level during 24 hours	±1%	±1%	±1%	±1%
2.1.2 NON-LINEARITY DISTORTION				
a Luminance signal				
i Line time non-linearity	5%	10%	8%	13%
ii Chrominance-luminance crosstalk[20]	+.5%	−7.5+2%	+1.5%	−7.5+2%
b Chrominance signal				
i Differential phase	±5°	±10°	±7°	±12°
ii Differential gain	±5%	±10%	±8%	±13%
c Dynamic gain				
i Luminance	±2%	±2%	±2%	±2%
ii Chrominance	±2%	±2%	±2%	±2%
iii Sync	±2%	±2%	±2%	±2%
d Transient crushing				
i Luminance	±5%	±7%	±5%	±7%
ii Chrominance	±5%	±7%	±5%	±7%
iii Sync	±3%	±4%	±3%	±4%
2.1.3 LINEAR DISTORTION				
2.1.3.1 *Waveform distortion*				
a 2T Pulse-and-bar				
i Pulse/bar ratio[21]	1.5% K	2.5% K	2% K	3% K
ii 2T pulse response	2% K	3.5% K	3% K	4.5% K
iii 2T bar response	1.5% K	2.5%	2% K	3% K
b 50 Hz square wave response	1% K	1% K	1% K	1% K
c Sync				
i Overshoots	6%	6%	8%	8%
ii Tilt	3%	3%	4%	4%

PARAMETER	MAIN STATION	MAIN STATION RBR FED	TRANSPOSER FROM STATION	TRANSPOSER FROM RBR STATION
2.1.3.2 *Luminance-chrominance inequalities*				
a Gain[22]	±4%	±8%	±8%	±11%
b Delay	±20 ns	±40 ns	±30 ns	±45 ns
2.1.3.3 *Input and output impedance*				
a Return loss	−30 dB	—	—	—
2.1.4 NOISE				
a Continuous random noise[23]				
i Weighted luminance	−57 dB	−50 dB	−51 dB	−48 dB
ii Weighted chrominance	−52 dB	−48 dB	−48 dB	−46 dB
b Periodic noise	−48 dB	−48 dB	−45 dB	−45 dB
c LF noise	−48 dB	−48 dB	−45 dB	−45 dB
d Interchannel crosstalk	−55 dB	−55 dB	−55 dB	−55 dB
2.1.5 MODULATION DERIVED DISTORTION				
a Intermodulation products[24]	—	—	−35 dB	−35 dB
b Incidental phase modulation	−48 dB	−45 dB	−46 dB	−43 dB
2.1.6 SIGNAL PARAMETERS				
a Timings and rise times[25]	To national specifications			
b Sub-carrier frequency[25]	To national specifications			
c Carrier frequency stability (Parts in 10^7)	5	5	8	8

References

[19]The corresponding composite video level at the transmitter input should be 1.0 V p-p.
[20]Crosstalk as measured should be corrected by +7.3% to allow for demodulator distortion when envelope detection is used.
[21]Pulse-to-bar ratio as measured should be corrected by +5% to allow for demodulator distortion when envelope detection is used.
[22]Gain inequality as measured should be corrected by +4.3% to allow for demodulator distortion when envelope detection is used.
[23]Noise should be measured using a passive dsb detector.
[24]Measured using a 2Tc pulse-and-bar at standard level. The significant intermodulation products occur as 1.57 MHz and 2.86 MHz. Since they appear in the presence of white noise at a relatively high level, measurements will involve a special procedure such as the use of a spectrum analyser or suitable band-pass filters with the noise meter.
[25]See *Specification of Television Standards for 625-line System I Transmissions.*

Specification of 625-line Video Distortion Measurements

Synopsis
The specification deals with all the parameters used by the IBA for the assessment of System I video performance. It is in two parts: the first part provides a list of the parameters together with the related CCIR recommendations, where appropriate, and the second section provides definitions of the measurement procedures agreed by the IBA's Measurement Techniques Standardisation Committee.
The specification is used by both the IBA and the ITV programme companies in measuring video distortions at any point in the broadcast chain including cameras, telecines, VTR machines, links and lines networks, and is used in conjunction with the Codes of Practice which lay down the various parameter tolerances.

SYSTEM I VIDEO PARAMETERS

PARAMETER	CCIR Rec. 451 Reference
1. Output Signal Level	
a Insertion gain	4.1
b Insertion gain stability	4.2
2. Non-Linear Distortion	
Note that all the following tests may also be carried out where appropriate at +3 dB.	4.7
a Luminance signal	
i Line-time non-linearity	4.7.1
ii Chrominance-luminance crosstalk	3.4.1.4 (CMTT/1040-E)
b Chrominance signal	
i Differential phase	4.7.2
ii Differential gain	4.7.2
c Dynamic Gain	
i Luminance	Not defined
ii Chrominance	Not defined
iii Sync	4.8
a Transient non-linearity	
i Luminance	Not defined
ii Chrominance	Not defined
iii Sync	Not defined
3. Linear Distortion	
3.1 Waveform Distortion	
a 2T pulse-and-bar	
i Pulse/bar ratio	4.9.1
ii 2T pulse response	4.9.1
iii 2T bar response	4.9.1
b 50 Hz Square wave response	4.9.1
c VLF response	Not defined
d T pulse response	Annex. 2.4
e Sync	
i Overshoots	Not defined
ii Tilt	Not defined
3.2 Luminance-Chrominance Inequalities	
a Gain	4.10.1
b Delay	4.10.1
3.3 Input and Output Impedance	
a Return loss	3.1
4. Noise	
a Continuous random noise	4.3
i Unweighted	Not defined
ii Weighted luminance	4.3.1
iii Weighted chrominance	4.3.2
b Periodic noise	4.4
c LF noise	4.4
d VLF noise	Not defined
e Impulse noise	4.5
f Moiré	Not defined
g Interchannel crosstalk	4.6
5. Modulation Derived Distortion	
a Intermodulation products	Not defined
b Incidental phase modulation	Not defined
c Sound-vision crosstalk	Not defined

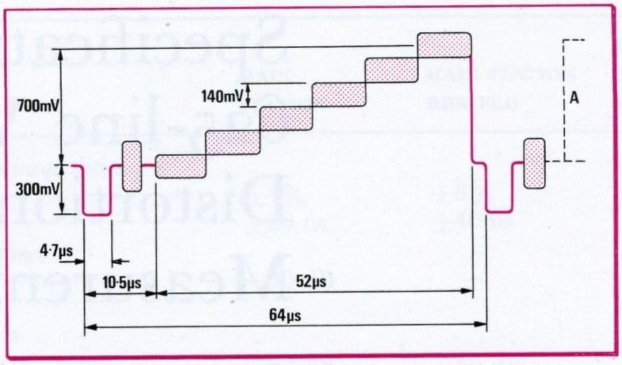


Fig. 1. Staircase test signal (A represents three lines at black level or three lines at white level).

DEFINITION OF MEASUREMENT PROCEDURES

Wherever appropriate the definitions have been derived from CCIR Rec. 451. Any departure from this procedure has been noted.

It should be noted that whenever measurements are made following equipment which incorporates envelope detection, a phase-linear 5.5 MHz band-restricting filter should be inserted between the equipment and the measuring apparatus.

1. Output Signal Level

a INSERTION GAIN

Insertion gain should be measured under the following conditions.

At the sending end a 75 Ω generator of the 2T pulse-and-bar test signal shown in Fig. 3 should be adjusted so that if connected directly to a 75 Ω load the bar amplitude would be 700 mV and the synchronising pulse amplitude 300 mV. The sine-squared pulse is ignored in this application. At the receiving end the bar amplitude (between the points 'a' and 'b' shown in Fig. 3) should be measured with a 75 Ω oscilloscope. The ratio of this amplitude to 700 mV, expressed in dB, is taken as the insertion gain.

b INSERTION GAIN STABILITY

This parameter is a measure of the change in insertion gain over a period of one hour.

2. Non-Linear Distortion

Line-time non-linearity and differential phase and gain are measured with the test signal shown in Fig. 1 which consists of a five-riser staircase, with superimposed sub-carrier, in every fourth line. Separate measurements are made with the three intermediate lines at black level and white level, and the higher value of distortion is taken as the result.

a LUMINANCE SIGNAL

i *Line-time non-linearity*

At the measurement point, the test signal is passed through a differentiating and shaping network which eliminates the sub-carrier and transforms the staircase into a train of five pulses of approximately sine-squared shape with 2 μs half-amplitude duration. Comparing the amplitudes of the pulses, the numerical value of the distortion is found by expressing the difference between the largest and smallest amplitude as a percentage of the largest.

ii *Chrominance-luminance crosstalk*

The 2Tc pulse-and-bar waveform shown in Fig. 2 should be used for this test. The crosstalk, which manifests itself as a change in the mean level of the pedestal during the transmission of the chrominance component, should be expressed as a percentage of picture level. Picture level is equivalent to the bar amplitude as measured in Section 1 (*a*).

b CHROMINANCE SIGNAL

i and ii *Differential phase and gain*

At the measurement point, the sub-carrier is filtered from the rest of the test signal and its six sections are compared in amplitude and phase. Taking the blanking-level section of sub-carrier as reference the differential gain is defined as the largest departure from the reference amplitude expressed as a percentage, and the differential phase is defined as the largest departure from the reference phase-angle, expressed in degrees.

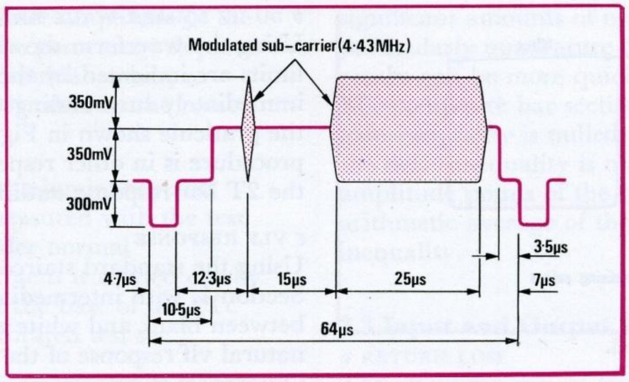


Fig. 2. 2Tc pulse-and-bar test signal (Tc=500 ns).

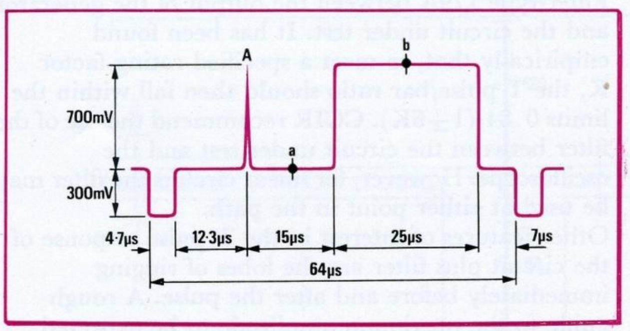


Fig. 3. 2T pulse-and-bar test signal (A=2T pulse; T=100 ns).

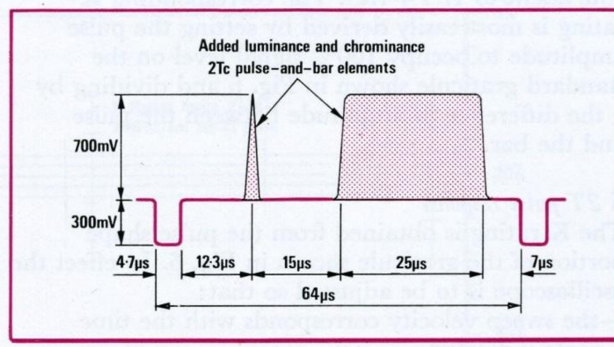


Fig. 4. 2Tc composite pulse-and-bar test signal (Tc=500 ns).

c DYNAMIC GAIN
The intermediate lines of the staircase waveform are alternated between black and white. The dynamic gain of the luminance, chrominance or sync signal is defined as:

$$DG = \frac{2(E_{\max} - E_{\min})}{(E_{\max} + E_{\min})} \times 100\%$$

where E is the p-p voltage of the luminance, chrominance or sync signals respectively. The p-p chrominance voltage should be measured on the third step.

d TRANSIENT NON-LINEARITY
Measured as the transient change in amplitude of the luminance, chrominance and sync level with change in intermediate lines from black to white and white to black, expressed as a percentage of the luminance, chrominance and sync amplitude respectively. The higher value of distortion is taken as the result.

3. Linear Distortion

3.1 Waveform Distortion

a 2T PULSE-AND-BAR
The distortions in this section are found from the waveform response to the pulse-and-bar and 50 Hz square-wave test signals shown in Figs. 3 and 4 when compared with the limits engraved on a K rating graticule. IBA graticule No. 234 shown in Fig. 6, is suitable for this measurement. The result is expressed as a rating factor K as described below.

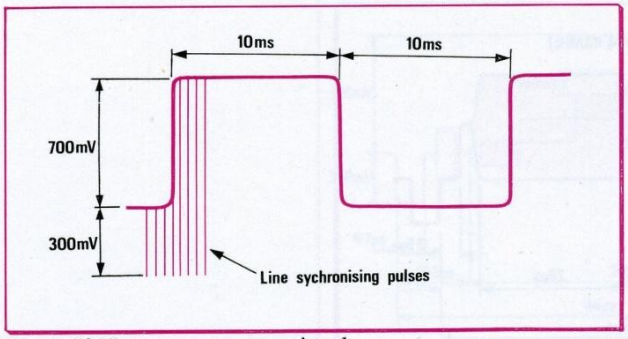


Fig. 5. 50 Hz square-wave test signal.

i *2T pulse-to-bar ratio*
The ratio of the amplitude of the 2T pulse response to the amplitude of the 2T bar response is equivalent to $1/(1 \pm 4K)$. The corresponding K rating is most easily derived by setting the pulse amplitude to occupy 100% signal level on the standard graticule shown in Fig. 6 and dividing by 4 the difference in amplitude between the pulse and the bar.

ii *2T pulse response*
The K rating is obtained from the pulse shape portion of the graticule shown in Fig. 6. In effect the oscilloscope is to be adjusted so that:
—the sweep velocity corresponds with the time scale indicated.
—the black level of the response coincides with the horizontal axis.
—the peak of the response falls on the unit-amplitude line.
—the half-amplitude points of the response are symmetrically disposed about the vertical axis.
When measuring the performance of a vsb system, which includes an envelope detector, the HAD of the pulse should be ignored.

iii *2T bar response*
The 2K and 4K limits are indicated by the horizontal lines immediately surrounding the 100% signal level on the graticule shown in Fig. 6.
In effect the oscilloscope is to be adjusted so that the half-amplitude points of the bar transitions coincide with the 50% markers at the left and right extremities of the graticule, and the middle of the bar is coincident with the centre marker on the 100% line. The first and last 2.5% of the bar, as marked on the graticule, should be ignored when carrying out the measurement.

b 50 HZ SQUARE-WAVE RESPONSE
Using the waveform shown in Fig. 5 the 1K and 2K limits are indicated by the horizontal lines immediately surrounding the 100% signal level on the graticule shown in Fig. 6. The measuring procedure is in other respects identical to that for the 2T bar response outlined in 3.1 *a* iii, above.

c VLF RESPONSE
Using the standard staircase waveform as defined in Section 1, with intermediate lines alternating between black and white at a rate slower than the natural vlf response of the system under test. Overshoots to be expressed as a percentage of standard picture level (700 mV p-p).

d T PULSE RESPONSE
T pulse measurements are made using a PO Link Filter type 179A between the output of the generator and the circuit under test. It has been found empirically that, to meet a specified rating factor K, the T pulse/bar ratio should then fall within the limits $0.84/(1 \pm 6K)$. CCIR recommend the use of the filter between the circuit under test and the oscilloscope. However, for linear circuits the filter may be used at either point in the path.
Other features of interest in the T pulse response of the circuit plus filter are the lobes of ringing immediately before and after the pulse. A rough guide to the maximum amplitude to be expected under normal conditions is given below:

LOBE	UPPER LIMIT OF LOBE AMPLITUDE EXPRESSED AS PERCENTAGE OF BAR AMPLITUDE. K=1%	K=5%
First (negative), leading or trailing	12	20
Second (positive), leading or trailing	8	12

e SYNC
i and ii *Overshoots and tilt*
Sync pulse overshoots and tilt should be expressed as a percentage of the sync pulse amplitude.

3.2 Luminance-Chrominance Inequalities

a GAIN
Gain inequality is measured using the test signal shown in Fig. 6. In the absence of chrominance-to-luminance crosstalk the measurement may be carried out by nulling the irregularities at the base of the 2Tc composite pulse with a calibrated test set.

Alternatively, the chrominance amplitude of the 2Tc bar is measured and the percentage departure from the amplitude of the luminance bar, as measured in Section 1 (*a*), is taken as the result.

b DELAY

Delay inequality between the luminance and chrominance channels is measured with the test signal shown in Fig. 4. Under normal circumstances this measurement is carried out by nulling the irregularities at the base of the 2Tc composite pulse with a calibrated test set.

When delay inequality is accompanied by significant amounts of non-linearity distortion, particularly quadrature distortion, less ambiguous results can be more quickly obtained by using the 2Tc composite bar section of the waveform. The gain inequality is nulled at the centre of the bar and the delay inequality is nulled at each of the half-amplitude points of the bar transitions in turn. The arithmetic average of the two readings is the delay inequality.

3.3 Input and Output Impedance

a RETURN LOSS

The waveform return loss is measured using the

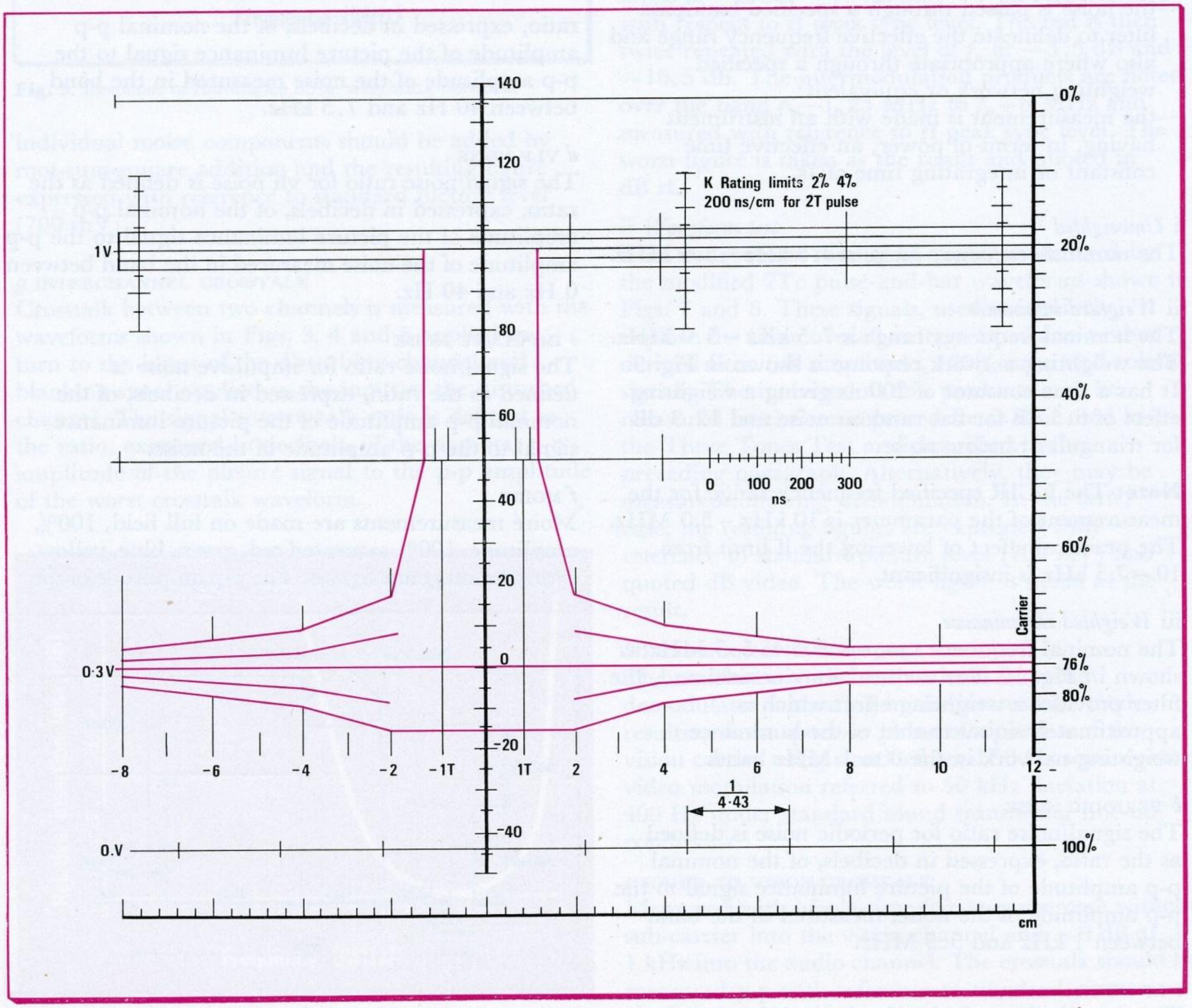


Fig. 6. IBA K rating graticule.

waveforms shown in Figs. 3, 4 and 5 and the result is taken as the ratio, expressed in decibels of the p-p voltages of the picture portions of the incident and reflected waveforms. The worst figure derived from measurement of all three waveforms is taken as the result.

4. Noise

a CONTINUOUS RANDOM NOISE

The signal/noise ratio for continuous random noise is defined as the ratio expressed in decibels of the nominal p-p amplitude of the picture luminance signal to the rms amplitude of the noise measured under the following conditions:

—the noise is passed through a specified bandpass filter to delineate the effective frequency range and also where appropriate through a specified weighting network or equivalent:

—the measurement is made with an instrument having, in terms of power, an effective time constant or integrating time of 1s.

i *Unweighted*

The nominal frequency range is 7.5 kHz – 5.5 MHz.

ii *Weighted luminance*

The nominal frequency range is 7.5 kKz – 5.0 MHz. The weighting network response is shown in Fig. 9. It has a time constant of 200 ns giving a weighting effect of 6.5 dB for flat random noise and 12.3 dB for triangular random noise.

Note: The CCIR specified frequency range for the measurement of the parameter is 10 kHz – 5.0 MHz. The practical effect of lowering the lf limit from 10 – 7.5 kHz is insignificant.

iii *Weighted chrominance*

The nominal frequency range is 3.5 to 5.5 MHz as shown in Fig. 10. For each sub-carrier sideband, the filter provides a weighting effect which is approximately equal to that of the luminance weighting network in the 0 to 1 MHz band.

b PERIODIC NOISE

The signal/noise ratio for periodic noise is defined as the ratio, expressed in decibels, of the nominal p-p amplitude of the picture luminance signal to the p-p amplitude of the noise, measured in the band between 1 kHz and 5.5 MHz.

c LF NOISE

The signal/noise ratio for lf noise is defined as the ratio, expressed in decibels, of the nominal p-p amplitude of the picture luminance signal to the p-p amplitude of the noise measured in the band between 40 Hz and 7.5 kHz.

d VLF NOISE

The signal/noise ratio for vlf noise is defined as the ratio, expressed in decibels, of the nominal p-p amplitude of the picture luminance signal to the p-p amplitude of the noise measured in the band between 0 Hz and 40 Hz.

e IMPULSIVE NOISE

The signal/noise ratio for impulsive noise is defined as the ratio, expressed in decibels, of the nominal p-p amplitude of the picture luminance signal to the p-p amplitude of the noise.

f MOIRE

Moiré measurements are made on full field, 100% amplitude, 100% saturated red, green, blue, yellow, cyan and magenta signals. The p-p amplitude of the

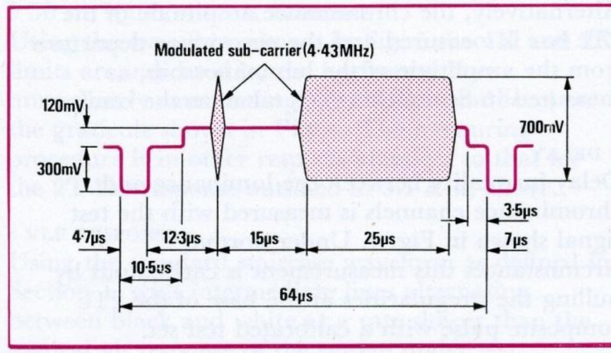


Fig. 7. Modified 2Tc pulse-and-bar test signal A.

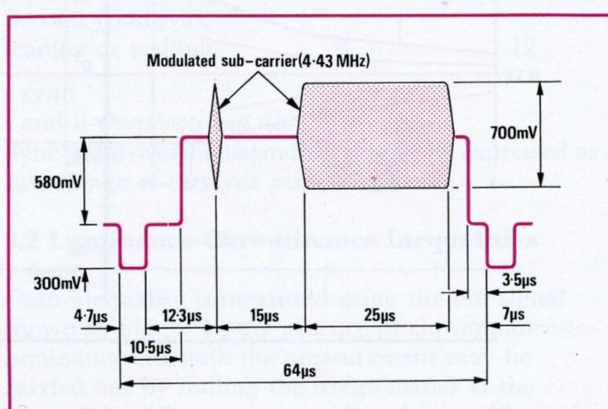


Fig. 8. Modified 2Tc pulse-and-bar test signal B.

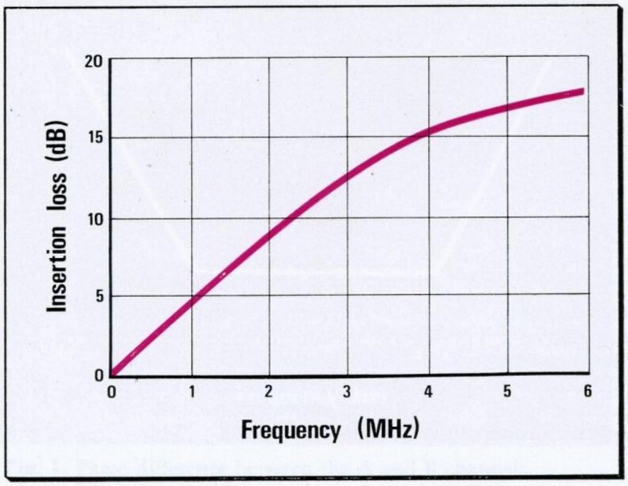


Fig. 9. Response of luminance noise weighting network.

individual moiré components should be added by root-sum-square addition and the resulting figure expressed with reference to standard picture level (700 mV).

g INTERCHANNEL CROSSTALK

Crosstalk between two channels is measured with the waveforms shown in Figs. 3, 4 and 5 applied in turn to the input of the disturbing channel and blanking syncs applied to the input of the disturbed channel. The signal-to-crosstalk ratio is defined as the ratio, expressed in decibels, of the nominal p-p amplitude of the picture signal to the p-p amplitude of the worst crosstalk waveform.

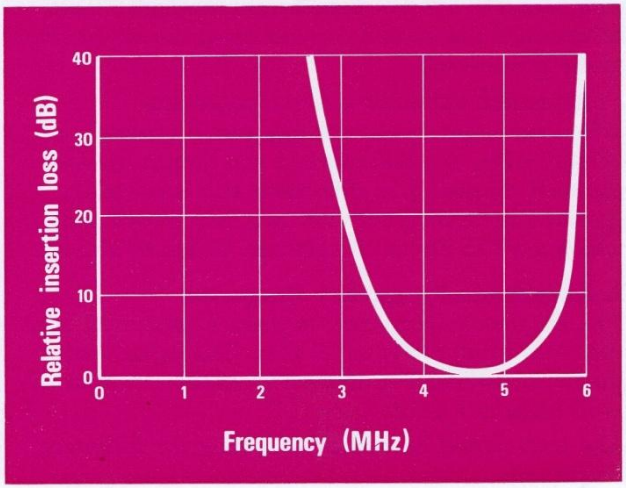


Fig. 10. Response of chrominance noise weighting network.

5. Modulation Derived Distortion

a INTERMODULATION PRODUCTS

Intermodulation distortion should be measured by one of the two methods outlined below. The two different tests produce the same range of signal levels in the rf domain and therefore the method appropriate to the situation may be used. Since the reference for the distortion is rf peak sync or peak video respectively, the figure referred to the video signal will be 17 dB worse than that referred to the rf signal.

i *Three tone test*

Three tones are used at frequencies f_v, f_{sc} and f_s at levels of —8 dB, —17 dB and —7 dB respectively, with respect to rf peak sync level. The test is then twice repeated with the level of f_v at —3.5 dB and —10.5 dB. The intermodulation products are noted over the band f_v—1.25 MHz to f_v+6 MHz and measured with reference to rf peak sync level. The worst figure is taken as the result and quoted in dB rf.

ii *Waveform test*

This test requires the use of carrier modulated by the modified 2Tc pulse-and-bar waveforms shown in Figs. 7 and 8. These signals, used successively, explore the same overall voltage excursion as that derived from full amplitude, 100% saturated colour signals. The intermodulation products may be measured by the same procedure as that used in the Three Tones Test and described in the preceding paragraph. Alternatively, they may be measured following demodulation. In the latter case, the resulting figures are expressed with reference to standard picture level (700 mV) and quoted dB video. The worst figure is taken as the result.

b INCIDENTAL PHASE MODULATION

The maximum audio output level from the demodulator, operating in the intercarrier mode, resulting from spurious phase modulation of the vision carrier using standard level 50 Hz square-wave video modulation referred to 50 kHz deviation at 400 Hz under standard sound transmitter line-up conditions.

c SOUND TO VISION CROSSTALK

Measured with whole-time five-step staircase without sub-carrier into the vision channel and +8 dB at 1 kHz into the audio channel. The crosstalk should be measured p-p with reference to standard picture level (700 mV p-p).

Specification of Audio Distortion Measurements

Synopsis
As a companion to the specification on video distortions, the IBA also issues a specification on audio distortion measurements, drafted by the Measurement Techniques Standardisation Committee. It embraces local radio performance as well as television sound, and deals with measurement methods covering all points in the broadcast system including tape recorders, studio mixers, lines networks and transmitters.

The first section provides a list of these parameters together with related CCIR recommendations where appropriate. The second section provides definitions of the measurement procedures agreed by the IBA's Measurement Techniques Standardisation Committee. It is not implied that all parameters included in this specification should be measured.

Section 1
AUDIO PARAMETERS

1. Insertion Gain	*CCIR Reference*
a Adjustment error	Report 496
b Stability	Report 496
c Difference between A and B channels	Report 293–2
2. Amplitude-Frequency Response	Report 293–2
3. Group Delay Response	
a Group delay response	Report 496
b Phase difference between A and B channels	Report 293–2
4. Noise	Recommendation 468
a Wideband noise	Report 496
b Periodic noise	Report 496
c Impulsive noise	Not yet defined
5. Non-Linear Distortion	
a Harmonic factor	Report 496
b Intermodulation	Report 496
6. Crosstalk	
a Interchannel crosstalk	Report 496
b Crosstalk between the A and B channels of stereophonic systems	GPC/CP 119
c Vision-sound crosstalk	Not yet defined
7. Wow and Flutter	Recommendation 409–2

Section 2
DEFINITION OF MEASUREMENT PROCEDURES

Wherever appropriate the definitions have been derived from CCIR Report No. 496 and No. 293–2.

1. Insertion Gain

a ADJUSTMENT ERROR
When the input to a system has been adjusted to −10 dBm at 1 kHz the difference between this and the output level is the adjustment error.

b STABILITY
With the input level constant at −10 dBm any change in output level over the specified period is defined as the stability.
The specified periods are defined as follows:
Short term stability – the greatest change occurring in 1 minute
Medium term stability – the greatest change occurring in 1 hour
Long term stability – the greatest change occurring in a period of not less than 24 hours which should be specified and would depend upon the application of the procedure.

c DIFFERENCE BETWEEN A AND B CHANNELS
When the input levels to the A and B channels are at −10 dBm, the difference in the output levels is the A–B channel gain difference and is normally specified separately over the two frequency bands which are 125 Hz to 10 kHz and 40 Hz to 15 kHz.

2. Amplitude-Frequency Response
The amplitude-frequency response is measured over the band from 40 Hz to 15 kHz. The input level should be adjusted to achieve a reference output of −10 dBm at 1 kHz.

The tests should be carried out using the following frequencies:
40 Hz 60 Hz 125 Hz 250 Hz 500 Hz

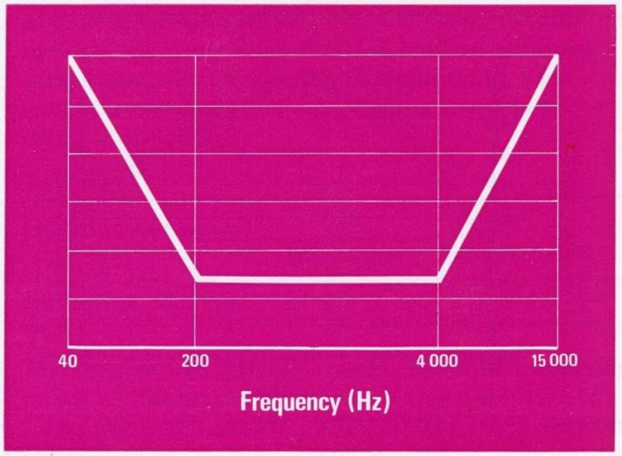


Fig. 1. Phase difference between the A and B channels.

1 kHz 2 kHz 4 kHz 6 kHz 8 kHz 10 kHz 12 kHz 14 kHz 15 kHz

Where the performance is defined separately for different parts of the frequency spectrum, it is recommended that where appropriate the band should be split as follows:
40 Hz to 15 kHz and
125 Hz to 10 kHz

The performance limits of PO circuits are presently defined in terms of an operating level of 0 dBm, and the PO are reluctant to adopt the same limits for a level of −10 dBm until the general introduction of carrier circuits. Therefore in the absence of any new agreement a level of 0 dBm will continue to be used for lines tests.

3. Delay Response

a GROUP DELAY RESPONSE
Not yet defined.

b PHASE DIFFERENCE BETWEEN A AND B CHANNELS
Phase difference should be measured over the frequency range from 40 Hz to 15kHz. The tolerance for a particular circuit or equipment is defined in the form of a profile; the break points for the profile should occur at frequencies of 200 Hz and 4 kHz as illustrated in Fig. 1.

4. Noise

All noise measurements should be expressed with reference to a 1 kHz tone at a level of 0 dBm. An audio weighting network, as defined in CCIR Recommendation 468, with an attenuation characteristic which follows the curve reproduced in Fig. 2 should be used. The input to the channel to be measured should be terminated.

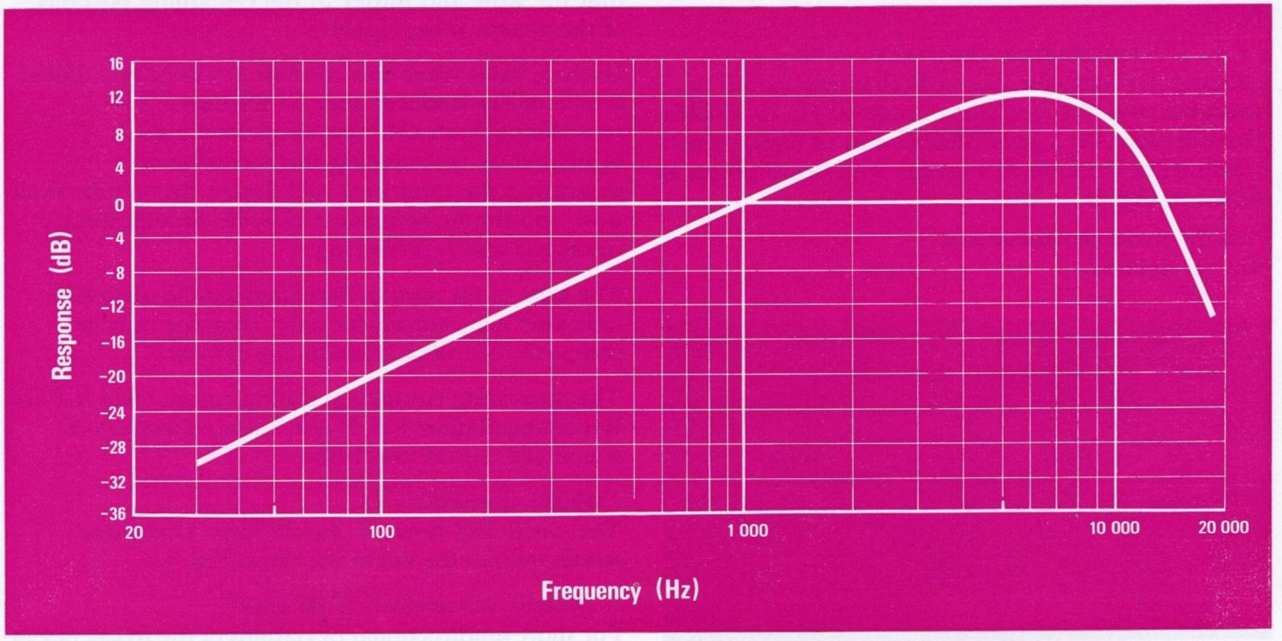


Fig. 2. Amplitude-frequency response characteristic of the weighting network to CCIR Recommendation 468-1.

a WIDE BAND NOISE
Wide band noise should be measured using a peak programme meter.

b PERIODIC NOISE
Periodic noise in the band 40 Hz to 15kHz is measured selectively and referred to zero level tone at 1 kHz measured on the same instrument.

c IMPULSIVE NOISE
Not yet defined.

5. Non-Linear Distortion

a HARMONIC FACTOR
Harmonic distortion measurement should be carried out using tones at 80 Hz and 1 kHz and at levels of −10 dBm, 0 dBm and +8 dBm. (Distortion should also be assessed at +14 dBm on studio paths.)

b INTERMODULATION
Not yet defined.

6. Crosstalk

a INTERCHANNEL CROSSTALK
Interchannel crosstalk should be measured on a PPM using frequencies in the band 40 Hz to 15 kHz at a level of 0 dBm on the interfering channel, with the input of the channel under test terminated. The crosstalk should be measured via a weighting network as defined in CCIR Recommendations 468, the attenuation characteristic of which is illustrated in Fig. 2.

b A TO B INTERCHANNEL CROSSTALK
Crosstalk between the A and B channels should be measured over the frequency range 40 Hz to 15 kHz. The tolerance for a particular circuit or equipment is defined in the form of a profile with break points as shown in Fig. 3.

c VISION TO SOUND CROSSTALK
Not yet defined.

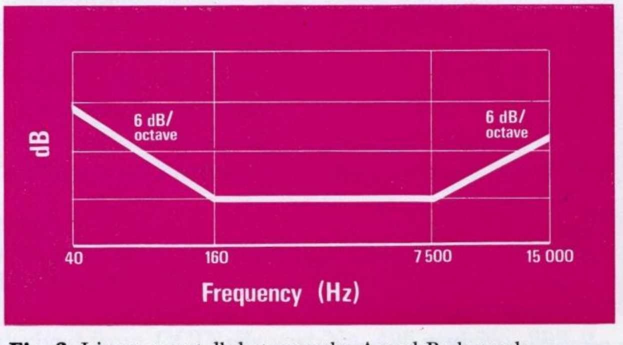


Fig. 3. Linear crosstalk between the A and B channels.

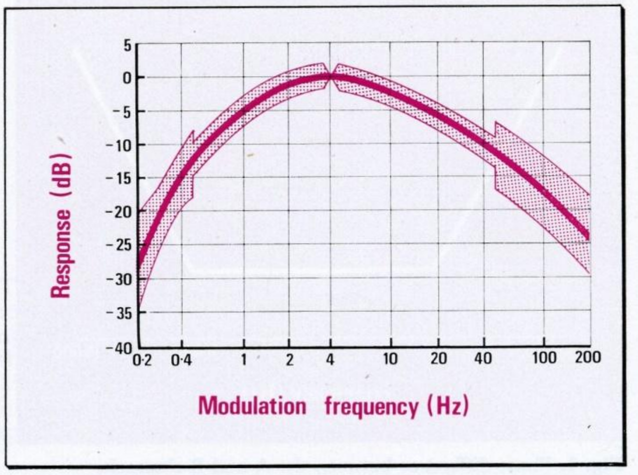


Fig. 4. Amplitude-frequency response characteristic of the weighting network to CCIR Recommendation 409-2.

7. Wow and Flutter

Wow and flutter should be measured at a test frequency of 3.15 kHz. The resulting wow and flutter frequencies in the range 200 mHz to 200 Hz should be measured peak weighted using a meter with dynamic characteristics which are defined below. Measurements should preferably be made on one element only of the system (either the recorder or the reproducer, but not both) under such conditions that the wow and flutter in the remaining portions of the system is negligible.

In those cases when this condition cannot be fulfilled, a recorder-reproducer may be measured by recording a 3.15 kHz test frequency, and subsequently reproducing this record and measuring the total wow and flutter. In no case shall wow and flutter be measured while simultaneously recording and reproducing.

The part of the system measured should always be indicated e.g. reproducer only, recorder only or complete recording-reproducing system.

The measuring equipment should comply with CCIR Recommendation 409–2, the relevant sections of which are reproduced below.

i *Weighting network*
The weighting network should have a response which follows the curve shown in Fig. 4.

ii *Dynamic characteristics of the meter*
For short unidirectional deviations of the frequency of measurement (rectangular pulses of duration A)

with a repetition rate of 1 Hz, the meter should indicate the percentage B of the reading obtained with a sinusoidal frequency modulation of 4 Hz having a p-p deviation equal to the frequency swing of the pulse:

Table 1

Duration of impulse, A, (ms)	10	30	60	>100
Indication, B, (%)	21±3	62±6	90±6	100±4

The return time should be such that, when applying pulses of 100 ms duration with a repetition rate of 1 Hz, the meter should indicate (40±10)% between pulses.

iii *Indication*

The meter should measure p-p values, but the reading should indicate the wow in per cent (%) of the figure corresponding to one half the p-p value.

Television Programme Technical Quality Assessments and Reporting Procedure

Synopsis
Every IBA television transmission is carefully logged and assessed for quality. This work is carried out by skilled engineers at each of the Authority's regional control centres and programme technical quality reports are completed on every programme.
Given here is the IBA's specified reporting procedure for quality assessment together with facsimile completed reporting forms for locally originated programmes and networked programmes.

The Procedure

Each programme is to be assessed for its overall quality as originated, according to the following internationally used grading scale. Separate assessments are required for vision and for sound.

1. Excellent
2. Good
3. Fairly good
4. Rather poor
5. Poor
6. Very poor

There is some evidence that the six-point overall quality grading scale gives insufficient discrimination. The Technical Sub-Committee of the Standing Consultative Committee discussed this matter at its meeting held on the 11th December 1969. It was agreed that the situation would be considerably improved by using half grades.

Until further notice†, all overall quality assessments should be made using the six-point scale but, where appropriate, using half grades between grades 1 and 6. It is also most important that the full range of quality assessments should be applied.

Whenever the quality grading is other than 1, 1½ or 2, the impairment(s) responsible for the quality grading will also be graded on the following scale:

1. Imperceptible
2. Just perceptible
3. Definitely perceptible but not disturbing
4. Somewhat objectionable
5. Definitely objectionable
6. Signal unusable

It will be apparent that under the conditions already determined, grade 1 of this impairment scale will never be used. It is included for the sake of completeness.

The incidence of the impairment throughout the programme will be indicated by a grading on a third scale as follows:

1. Occasional short bursts
2. A single short period
3. Occasional short periods
4. A single prolonged period
5. Occasional prolonged periods
6. Throughout

The assessment of each programme will be made only at the transmitting station local to the studio from which the transmission is originated, whether this be live or from a recording. In those cases where a studio serves two transmitting stations, only one station will be required to carry out the assessment. Advertisements will not be included in the assessment because they are already reported on separately from programmes.

† *Later in 1977, it is likely that the Independent Television network will discontinue the use of the above 6-point scales and adopt instead an inverted 5-point quality-grading system recommended by the CCIR. At the same time it is expected that a revised reporting procedure will also be brought into use.*
Details of both these revisions will appear in a later edition of IBA Technical Review.

Action Required at Nominated Stations
At the conclusion of each locally-originated programme, the monitoring engineer will enter in ink on a Programme Technical Quality Report Type A his assessment of the programme quality, using Scale 1.

Any significant technical impairments observed in the programme which are confirmed by the Programme Contractor's staff as originated in the studio are to be identified by entering the appropriate numbers shown below. The severity and duration of each impairment is to be assessed using Scales 2 and 3 respectively.

In a small number of cases it may be obvious that certain technical impairments are inevitably due to the use of exceptionally old films or recordings. Provided that the nature of the programme clearly justifies the inclusion of such material and that nothing can be done to improve its technical quality, the relevant faults need not be included in the assessment. All other faults, i.e. those not resulting from the age of the material, should be included.

When programmes scheduled for colour transmission appear with a monochrome content, they must be assessed for technical quality as monochrome programmes. Since it is necessary for the Authority to maintain a careful watch on the number of advertised colour programmes which contain a high proportion of monochrome material, the Quality Control Section is required to compile two-monthly assessments showing the technical performance of each company under three separate headings:

a Scheduled colour programmes
b Scheduled monochrome programmes
c Scheduled colour programmes which appear with a monochrome content of 10% or more, or three minutes or more (whichever is the less)

To provide the necessary information the Quality Report Type 'A' should show the appropriate classification for each programme. This should be done by inserting 'C', 'M' or 'C/M' adjacent to each overall picture grading, to indicate the situations described in *a*, *b* and *c* respectively.

All gradings on the report will be based solely on the judgement of the station personnel and will not need verification by studio personnel.

Reports as completed by the monitoring engineers will be sent daily to Headquarters Quality Control Section. The titles of the programmes should be typed on the report but all other entries should be in the monitoring engineer's own handwriting.

Identification of Programme Source
Each nominated station will be responsible for determining which programmes it will be required to report on. The source of each programme should be apparent from the local Programme Contractor's Daily Routine Schedules and/or the IBA Links Allocation Schedules.

Local Impairment of Networked Programmes
On those occasions when irregularities at a local studio centre impair or further impair the technical quality of an incoming networked programme, the monitoring engineer at the transmitter affected will complete a Programme Technical Quality Report Type B which will be sent to Headquarters Quality Control Section.

Fault Reporting and Transmission Logging
Under this procedure for quality reporting, it is not necessary for stations to request local contractors to contact the remote source contractor. The local studio, however, must query with the local Post Office National Switching Centre any faults incoming from the network which have been reported to them by the transmitter.

Action at Headquarters
The information contained in completed Quality Reports Type A is sent to the appropriate programme contractor weekly in a decoded form. Information from Type B reports is also decoded and forwarded, as and when necessary, to the programme contractor.

VISION

1. Afterglow
A form of streaking experienced with flying-spot scanners, resulting from scanning-tube phosphor persistence. Highlights are followed by white streaking of duration proportional to the highlight area scanned.

2. Beam Flutter
A condition experienced with image orthicons where the scanning beam is deflected from its correct position by the accumulated charge on the target. It results in random amplitude variations in highlight areas.

3. Black Crushing
Loss of detail in dark areas due to non-linearity at the lower end of the grey scale.

4. Blemishes
Unwanted marks on picture caused by dirt in the optical system of camera or telecine, or due to imperfections on target and/or other elements of pick-up tubes.

5. Breaking-up
Intermittent momentary loss of picture signal.

6. Breathing
Slow, regular variation in signal amplitude and/or scanning amplitude.

7. Burnt-out Whites
Absence of highlight detail due to amplitude limiting.

8. Camera Mis-matching
When two or more cameras contributing to a programme are not similarly aligned, giving noticeable and unwanted changes in tonal rendition from scene to scene.

9. Colour Cast
An overall, unwanted colour bias on a particular programme which does not change significantly from source to source.

10. Colour Mis-matching
Changing colour balance with source changes in a particular programme.

11. Contrast, Lack of
Self-explanatory.

12. Crosstalk
Interference from an unwanted signal.

13. Definition, Lack of
Self explanatory.

14. Dirt in Film Gate
Self-explanatory.

15. Drop Outs
Random loss of signal from VTR source, normally of less than line duration, due to absence of oxide on magnetic tape or loss of flux-linkage between reproducing head and tape.

16. Echoes
A type of ghosting caused by a standards converter. Images, delayed by 36 and 72 picture elements occur as the result of residual charge in the store capacitors (See also "Ghosting").

17. Fading
Unwanted slow changes in signal level.

18. Field Delay Fault
A standards converter fault consisting of vertically moving horizontal black or noisy bars, possibly accompanied by flicker or double imaging.

19. Film Blemishes
Self-explanatory.

20. Film Editing Fault
Incorrect framing due to film editing.

21. Flare
Spurious picture signals caused by stray light in the source optical system.

22. Flicker
Alternating mean brightness on successive fields.

23. Flutter
A rapid fluctuation of signal level.

24. Flyback Brightening
Self-explanatory.

25. Focus, Lack of
Loss of both vertical and horizontal detail. When caused optically, it varies with the distance of objects from the camera.

26. Frame Bounce
Vertical picture bounce.

27. Frame Roll
Continuous vertical picture drift due to lack of synchronism.

28. Frame Shading
Unwanted brightness components superimposed on the picture in a vertical direction.

29. Frame Slip
Vertical picture drift through one frame only.

30. Gamma Error
Incorrect grey-scale reproduction.

31. Gate Static
Random white flashing caused by electrostatic discharges in film gate.

32. Geometric Error
Distortion of shape resulting from scanning non-linearity or incorrect scanning aspect ratio.

33. Ghosting
Spurious repetitive images resulting from signal reflections.

34. Grain
A type of noise resulting in a moving granulated picture background, caused by film emulsion having a granular structure whose individual particles are large compared with a television picture element.

35. Grey-Scale Mistracking
Level dependent colour balance.

36. Halo
Spurious dark areas surrounding a highlight region.

37. Head Banding
Changes in response with VTR head. In monochrome the changes are in frequency response. In colour they are accompanied by saturation changes and, in the case of converted NTSC signals, may be accompanied by hue changes.

38. Head Noise Banding
Difference in noise level between VTR heads.

39. Head Notching
Horizontal displacement of one line, or a few lines, occurring with TVR head switching.

40. Head Quadrature Errors
Horizontal displacement of complete bands of picture lines due to lack of precise quadrature between adjacent VTR heads.

41. Head Switching Transients
Transients resulting from incorrectly timed VTR head switching.

42. HF Noise
Spurious random components in picture background, of the order of a picture element in size.

43. Highlight Lag
Trailing on moving objects following normal picture highlights.

44. Highlight Tearing
Polarity changes of highlight picture areas caused by overdeviation in the VTR fm system.

45. Hum Bars
Simple horizontal bar pattern occurring at supply mains frequency and/or its harmonics.

46. Impulse Interference
Random light or dark spots.

47. Interlace Error
Unequal vertical spacing between the source scanning lines on successive fields causing a loss of vertical definition.

48. Inversion
Reversal of polarity of part or all of the picture signal.

49. Lag
Trailing on moving objects.

50. Level Variation
Slow, random changes in signal level.

51. LF Noise
Spurious random components in picture background, of the order of one line or more in duration.

52. Lighting Defects
Any picture degradation caused by a lighting condition which is not due to production requirements.

53. Line Flashing
The intermittent obliteration to black or white of the picture signal for periods between a fraction of a line and a number of lines.

54. Line Jitter
Random, irregular, horizontal line displacement.

55. Line Phase Modulation – Long Term
Horizontal, successive line displacement resulting from modulation of the line scan by another signal whose frequency is low compared with field frequency.

56. Line Phase Modulation – Short Term
Horizontal, successive line displacement resulting from modulation of the line scan by another signal whose frequency is high compared with field frequency.

57. Line Pulling
Intermittent horizontal line displacement in certain parts of the picture only.

58. Line Shading
Unwanted brightness components superimposed on the picture in a horizontal direction.

59. Line Tearing
Breaking up of a section of the picture due to loss of line synchronisation.

60. Logic Fault
A standards converter fault giving a picture consisting of a jumble of fragments in the wrong places.

61. Loss of Colour
Complete or partial loss of colour in part or all of the picture resulting from the absence of sub-carrier burst and/or the absence of chrominance information.

62. Loss of Picture
Self-explanatory.

63. Luminance-Chrominance Displacement
Lack of horizontal coincidence between luminance and the related chrominance information, due to timing errors in signal processing or luminance-chrominance delay inequality.

64. Microphony
A regular pattern of varying brightness superimposed on the picture due to unwanted acoustic modulation occurring in the video system.

65. Misregistration
Lack of positional coincidence between the three colour separation signals derived from the same point in the scene. (Due to lack of time coincidence at source.)

66. Mixed Sync Sources
Interference from another signal whose synchronising pulses are not coincident with those of the wanted signal.

67. Moiré
Spurious patterning resulting from beats between two or more periodic components.

68. Patterning
A regular pattern of varying brightness superimposed on the whole picture.

69. Print-Through
Crosstalk resulting from magnetic induction between adjacent layers in a reel of tape.

70. Puddling
An area of white, or colour, surrounding a moving speculum; normally proportionally larger than the original speculum image.

71. Racking Error
The result of incorrect film framing.

72. Ragging
Irregular serrations of picture verticals due to random line phase modulation by noise components.

73. Ringing
A series of spurious equidistant brightness transitions, of decreasing amplitude, following a picture transient.

74. Saturation Error – Level Dependent
Changes in saturation resulting from luminance changes, due to system differential gain distortion (and/or differential phase distortion when using PAL delay line decoding), or due to incorrect system gamma.

75. Saturation Error – Overall
Incorrect saturation, resulting from source errors or from system luminance-chrominance gain inequality.

76. Scalloping
A VTR fault whereby the bands of lines produced by each head transit contain curved verticals, due to incorrect vertical positioning of the tape guide.

77. Scratches
The result of scratches on film or, with VTR, noise flashes forming a geometrical pattern due to physical scratches on the magnetic oxide of the tape.

78. Shift Register Fault
A standards converter fault resulting in vertical bands, 12 picture elements in width, containing no picture information.

79. Sparkle, Excessive
Excessive amplitude of high-frequency picture components.

80. Sticking
Retention of a previous image as background to present scene.

81. Store Fault
A standards converter fault consisting of vertical bands containing no picture information. The bands may be one or four picture elements in width, dependent on the nature of the fault.

82. Streaking
A spurious, uniformly decayed brightness component following a bright or dark area. Referred to as 'short-term streaking' if the duration is a fraction of a line period, or as 'long-term streaking' if the duration is a line period or more.

83. Striations
Spurious vertical lines on the picture.

84. Venetian Blind Effect
A VTR fault whereby the band of lines produced by each head transit suffers from linear, successive, horizontal displacement. Due to incorrect horizontal positioning of the tape guide.

85. VTR Editing Fault
Any picture disturbance, such as loss of lock or mistracking, caused by faulty tape editing.

86. VTR Mistracking
Patterning and noise, in severe cases tending towards picture break-up, due to mis-alignment between VTR head and recorded tracks.

87. White Crushing
Lack of highlight detail caused by system non-linearity at the top end of the grey scale.

SOUND

1. Background Cues
Extraneous studio cues, prompts or talkbacks, etc., audible in programme background. May be due to electrical crosstalk.

2. Background Noise
Extraneous studio noise audible in programme background.

3. Balance Poor (Volume)
Incorrect relative levels between different sources contributing to the same programme.

4. Balance Poor (Tone)
Unwanted variations in tonal values between different sources contributing to the same programme.

5. Booming
Excessive bass reproduction or colouration by room acoustics.

6. Breaking-up
Intermittent partial or total loss of programme.

7. Buzz
Any spurious low-frequency background noise occurring at frequencies unrelated to power supply and audible at normal listening level.

8. Clicks
Self-explanatory.

9. Compression, Excessive
Too small a difference between minimum and maximum signal levels.

10. Crackle
Self-explanatory.

11. Crosstalk
Interference from an unwanted signal.

12. Distortion, Harmonic
Introduction of spurious harmonics due to system non-linearity or overloading.

13. Dynamic Range Error
Dynamic range different from the level limits appropriate to the type of programme.

14. Excessive Bass
Over-emphasis of low frequencies leading to 'heavy' sound quality.

15. Excessive Top
Over-emphasis of high frequencies leading to 'shrill' sound quality.

16. Flutter
Spurious, rapid (and often cyclic) changes in pitch of a recorded signal.

17. High Frequencies Lacking
Sound quality lacking in 'brilliance' or clarity.

18. High Level
Self-explanatory.

19. Hiss
Random hf noise background audible at normal listening level.

20. Howl-Round
Positive feedback from the output of a sound system to its input, leading to a rapid build-up of oscillation and consequent overload.

21. Hum
An unwanted background at power supply frequency and/or its harmonics.

22. Line Noise
Noise discernible as induction from PO or other circuits, such as dialling tone, ringing tones, clicks, etc.

23. Loss of Sound
Self-explanatory.

24. Low Frequencies Lacking
Sound quality 'thin'.

25. Low Level
Self-explanatory.

26. Plops
Self-explanatory.

27. Print Through
Crosstalk resulting from magnetic induction between adjacent layers in a reel of tape.

28. Repeating Groove
Self-explanatory.

29. Reverberation, Excessive
Reverberation too great in relation to programme content.

30. Rumble
Very low frequency noise, generated by faulty disc or tape reproducers.

31. Sibilance
Excessive reproduction of high-frequency speech components, leading to overloading and consequent distortion.

32. Singing
A spurious high-pitched tone background, usually caused by an oscillating sound system.

33. Sprocket Noise
A steady buzz on background of the sound from a telecine source. Due to film misalignment which allows the passage or sprocket holes to modulate the sound reproducing system.

34. Synchronisation Error
Lack of synchronisation between vision and the accompanying sound signal.

35. Wow
Spurious, slow (and often cyclic) changes in the pitch of a recorded sound signal.

36. Whine
A spurious high-pitched tone background subject to slow random changes in frequency.

37. Wind Noise
Self-explanatory.

INDEPENDENT BROADCASTING AUTHORITY — Page 1 of 1

Circulation: (1) H.Q.C.
(2) File

PROGRAMME TECHNICAL QUALITY REPORT TYPE 'A'

Programme Contractor: ANGLIA — Monitoring Station: MENDLESHAM — Date: 26.02.77

Programme Title	In appropriate large box insert overall grading (Scale 1) if not Grade 1 or 2 show numerical reason, severity (Scale 2) and time factor (Scale 3).					Sig.
Fantastic Voyage C	Picture grade 3	Reason Severity Time factor	13 3 6	Sound grade 2		J Hunt
Clapperboard C	Picture grade 2	Reason Severity Time factor		Sound grade 2		J Hunt
Space 1999 C	Picture grade 2	Reason Severity Time factor		Sound grade 2		J Hunt
Weather Forecast C	Picture grade 2	Reason Severity Time factor		Sound grade 2		B Pittock
Batman "Pop Goes the Joker" C	Picture grade 3	Reason Severity Time factor	13 3 6	Sound grade 2(3)		B Pittock
Cartoon-Popeye "All's Fair at the Fair" C	Picture grade 3	Reason Severity Time factor	13 3 6	Sound grade 2½(2)	17 3 6	B Pittock
Weather Forecast C	Picture grade 2	Reason Severity Time factor		Sound grade 2		B Pittock
The Company Men. C	Picture grade 2½	Reason Severity Time factor	3 13 3 3 5 5	Sound grade 2		B Pittock

INDEPENDENT BROADCASTING AUTHORITY

Sheet ...1... of ...1...

Date:- 26/2/77

Circulation: (1) HQC
(2) File

Programme Technical Quality Report Type 'B'

This report is to be completed when a network programme is impaired or further impaired by an operational error or equipment irregularities at the local studio.

Local Programme Contractor:- ...ULSTER TV... Monitoring Station:- ...CALDBECK...

Programme title:- WORLD OF SPORT Networking Contractor:- LWT

Details and duration of local studio fault(s):- PRESENTATION FAULT AT UTV CAUSED AD. BREAK TO OVER-RUN 34 SECS. (1401.10 – 1401 44)

Numerical effect of fault(s) (see overleaf) Pictures:- 62 Sound:- 23

Degree of impairment (use scale 2) Pictures:- 6 Sound:- 6

Overall programme grading (use scale 1)

(1) With above fault(s) Pictures:- 2 Sound:- 2

(2) Without above fault(s) Pictures:- 2 Sound:- 2

Assessment made by: R Spencer

Programme title:- Networking Contractor:-

Details and duration of local studio fault(s)

Numerical effect of fault(s) (see overleaf) Pictures:- Sound:-

Degree of impairment (use scale 2) Pictures:- Sound:-

Overall programme grading (use scale 1)

(1) With above fault(s) Pictures:- Sound:-

(2) Without above fault(s) Pictures:- Sound:-

Assessment made by: ....

Code of Practice for Independent Local Radio Studio and Outside Broadcast Performance

Synopsis
The IBA, under the terms of the Independent Broadcasting Authority Act 1973, is responsible for the maintenance of technical standards in Independent Local Radio. The Code of Practice reproduced here has been drawn up by the IBA's Quality Control Section in consultation with other IBA engineering departments, the ILR programme companies and the broadcasting industry. It sets out the tolerances and operational standards of performance which should be aimed for on a day-to-day basis in ILR studio centres and at outside broadcast locations.

Section 1
DEFINITIONS AND OPERATIONAL PRACTICES

1.1 General

This Code of Practice defines the technical requirements applicable to studio centres and outside broadcasts. It is not intended for use as an equipment specification and it will be revised periodically to take account of developments in equipment. However, tolerances will not be tightened beyond the point where satisfactory subjective quality has been achieved. The Code specifies all those parameters which should be met to ensure satisfactory quality of reproduction. Where it is necessary to share the allowable distortions between different parts of the system, this has been done in such a way that

i technically achievable tolerances are specified for each part of the system

and ii it leads to the most economical overall system.

For clarity, explanatory information concerning the individual tests has been included in each section. Test parameters have been based upon CCIR recommendations where appropriate. Day-to-day operation should aim at a performance within the tolerances quoted.

Since some audio parameters are currently under discussion by the CCIR and by UK broadcasters, it will be necessary from time to time for the Authority to re-issue this Code of Practice. Where doubt arises concerning the details of specifications and measurements, advice should be sought from the Authority.

1.2 Outside Broadcasts including News, Sport and Current Affairs

For outside broadcasts of all types, including current affairs, news, sport, music and drama, equipment of broadcast quality should be used wherever possible.

Where the use of broadcast quality equipment is impractical the use of equipment of reduced technical performance, e.g. telephones and communications links, is permissible for the monophonic broadcasting of reports and interviews. Wherever possible, efforts should be made to improve poor quality material by the use of noise reduction and equalisation techniques.

1.3 Signal Paths

Five signal paths are specified:—

i Studio path.
ii Worst path.
iii OB equipment path.
iv News equipment and links.
v Outside broadcast radio links.

The first four of these paths are dealt with in Section 2 and the fifth in Section 3. For the purpose of measurement, the above paths are defined as follows:—

i STUDIO PATH

a Studio microphone inlets, or line level inputs.
b Studio mixer.
c Main outputs of studio.
(All limiters to be by-passed.)

ii WORST PATH

a Source studio microphone inlets.
b Source studio mixer.
c Permanent tie lines.
d A second studio mixer.
e Permanent tie lines.
f Presentation/'on-air' mixer.
g Outgoing distribution amplifier(s).
h Station output terminals.
(All limiters to be by-passed.)

iii OB EQUIPMENT PATH

a Microphone inlets, or line level inputs.
b OB mixer.
c Output equipment, (measurements taken at the input to the PO line or radio link).
(All limiters to be by-passed.)

iv NEWS EQUIPMENT AND LINKS

a Source equipment.
b Radio link.
c Receiving equipment, (measurements taken at the output of the receiving equipment).

v OUTSIDE BROADCAST RADIO LINKS

a Radio links provided by programme contractors (Ref. *A*), (measurements taken at the input to PO line or contractor's studio equipment).

1.4 Tape Recorder and Reproducer Tolerances

Tape recorders and reproducers should employ CCIR/IEC equalisation characteristics (in accordance with IEC Publication 94, 3rd Edition, 1968).

The tolerances related to magnetic tape recorders (including tape cartridge machines) in Section 4 refer to a single recording made on one machine with replay on the same machine and on another having similar characteristics. The same tolerances are related to the replay of a standard CCIR test tape, where appropriate.

In principle, the requirements for the technical performance of cartridge machines should be the same as for reel-to-reel machines. However, the requirements of Section 4 relating to cartridge machines are considerably less stringent than those for reel-to-reel machines since, of necessity, they correspond with the capability of currently available equipment. Consequently, for the time being, cartridge machines should only be used for the origination of news inserts, commercials, presentation, promotion and announcements unless special circumstances preclude the origination of programme material using equipment of full broadcast performance.

It is recommended that recordings should be made using the following standard peak flux levels:—

Reel-to-reel machine (monophonic)	320 nWb/m
Reel-to-reel machine (stereophonic)	510 nWb/m
Cartridge machine (stereophonic)	405 nWb/m

1.5 Test Methods

Unless otherwise stated, measurement methods should comply with IBA recommendations, which are given after each section. These are based on CCIR and CMTT Recommendations where appropriate.

1.6 Signal Levels

In equipment, all signal levels are measured as voltages irrespective of impedance, and are quoted in decibels with reference to 0 dBu, where 0 dBu corresponds to 0.775 volts rms.

NB This definition of signal level applies only to equipment measurement. In the case of lines measurement, where complex impedances are frequently encountered, it is normal practice when setting levels to send from a specified source impedance and to substitute a fixed resistance (usually 600 ohms) at the point of measurement.

1.7 Studio Monitoring Requirements

1.7.1 PROGRAMME METERS

a Peak programme meters, which comply with BS 4297:1968, should be used for the monitoring of programme levels during recording and/or transmission. Under no circumstances should PPMs be connected directly across Post Office lines.

b The monitoring of transmission signals should be performed in such a way that the *A*, *B* and 'sum' signals can be monitored simultaneously using

PPMs. The level of the 'sum' signal should be adjusted to be 0 dBu when the *A* and *B* signals are individually at a level of −3 dBu.

1.7.2 VOLUME CONTROL LIMITS

The following table lists the volume levels on a 'sum' PPM to which the various categories of programme should be controlled. These levels are related to standard PPM readings with reference to a steady state reading of '4' corresponding to 0 dBu. The object of specifying these levels is to ensure that, so far as possible, the volume shall be subjectively consistent with the programme material while avoiding excessive loudness.

For correct use of this table the operator must be able to recognise varying degrees of compression so that subjective disturbances caused by excessive changes of loudness between similar material is avoided.

(*a*) *Peak Programme Levels at Station Output*

	TYPE OF PROGRAMME	NORMAL PEAKS	FULL RANGE
Speech:	Talks, news, drama documentaries, discussions, panel games, quiz shows	5	3–6
Music:	Variety, dance music	$4\frac{1}{2}$	2–6
	Brass bands, military bands	4	2–5
	Orchestral concerts	–	1–6
	Light music	$5\frac{1}{2}$	2–6
	'Pop' records (and any recorded programme) containing a high degree of compression	4	2–4
	Record programmes, live 'pop' shows, neither containing a high degree of compression	5	2–6
Commercials:	Highly compressed	4	2–4
	Slightly compressed	5	2–6

(*b*) *Use of Automatic Compression in Signal Path*

It is appreciated that normal operational requirements might call for the use of automatic gain control devices. The incorporation of such devices is permissible provided that they do not introduce compression of a ratio greater than 3:2, and that the attack and decay times used do not introduce significant 'pumping'. Where a special effect is occasionally required, more compression may be used, but, whatever degree of compression is employed, subjective loudness should not exceed that resulting from uncompressed material controlled to the limits specified in 1.7.2(*a*) above unless the special effect itself requires additional loudness.

When replaying programme material in which compression has been used during recording, no further compression should be introduced.

When automatic volume compression is used in stereophonic installations, the equipment characteristics should be such that no audible image shift occurs under any condition of operation.

1.7.3 MONITORING LOUDSPEAKERS

All monitoring of programme material by contractors during transmission and/or recording should be carried out using loudspeaker systems equivalent in performance to those used by the Authority. (Ref. *B*.)

1.7.4 STEREOPHONIC MONITORING

The positioning of loudspeaker systems for stereophonic monitoring should be such that the centre points of the hf units are 1.8 m apart at listening height. The line joining these two centre points then forms the base of an equilateral triangle, the apex of which should be the location of the monitoring position.

1.7.5 MONOPHONIC COMPATIBILITY

As the stereophonic transmission system utilises the sum of the *A* and *B* signals to provide a monophonic output, it is necessary to ensure that the 'sum' signal can be checked for compatibility. Ideally, the monophonic version of all programmes should be checked continuously in a separate cubicle. If this cannot be done, provision should be made for a facility to be readily available in the control/monitoring room(s), for allowing frequent periodic aural checks of the 'sum' signal to be made.

References to Section 1

A. *Outside Broadcast Radio Links* For measurement purposes the link should be set up on a line of sight path or on a test bench.

B. *Monitoring Loudspeakers* The Authority's specification for loudspeakers is in course of preparation.

Section 2
SIGNAL PATHS

PARAMETER	TOLERANCES			
	STUDIO PATH	WORST PATH	OB EQUIPMENT PATH	NEWS EQUIPMENT AND LINKS
2.1 a Gain Adjustment Error[A]	±0.5 dB	±0.5 dB	±0.5 dB	±1 dB
b Gain Stability[B]	±0.5 dB	±0.5 dB	±0.5 dB	—
2.2 Amplitude-Frequency Response (wrt 1 kHz)[C]				
i 40 Hz to 15 kHz	±1.0 dB	+1.0/−2.0 dB	±1.0 dB	—
ii 125 Hz to 10 kHz	±0.5 dB	+0.5/−1.0 dB	±0.5 dB	—
iii 300 Hz to 5 kHz	—	—	—	±6 dB
2.3 Signal/Noise Ratio[D]				
i Weighted, random, peak (70 dB gain)	41 dB	40 dB	41 dB	—
ii Unweighted, random, peak (70 dB gain)	46 dB	45 dB	46 dB	—
iii Weighted, random, peak (50 dB gain)	55 dB	54 dB	55 dB	—
iv Unweighted, random, peak (50 dB gain)	58 dB	57 dB	58 dB	—
v Weighted, random, peak (0 dB gain)	60 dB	56 dB	60 dB	30 dB
vi Unweighted, random, peak (0 dB gain)	63 dB	59 dB	63 dB	33 dB
2.4 Interchannel Crosstalk[E]				
i Weighted, random, peak (70 dB gain)	51 dB	50 dB	51 dB	—
ii Weighted, random, peak (50 dB gain)	60 dB	60 dB	60 dB	—
iii Weighted, random, peak (0 dB gain)	60 dB	60 dB	60 dB	—
2.5 Harmonic Distortion[F]				
i 1 kHz at all levels up to 0 dBu	0.25%	0.50%	0.25%	—
ii 80 Hz at all levels up to 0 dBu	0.50%	1.00%	0.50%	—
iii 1 kHz at +8 dBu	0.25%	1.00%	0.25%	5.00%
iv 80 Hz at +8 dBu	0.50%	2.00%	0.50%	—
2.6 Level Difference Between A & B Channels[G]				
i 40 Hz to 15 kHz	1.0 dB	1.5 dB	1.0 dB	—
ii 125 Hz to 10 kHz	0.5 dB	1.0 dB	0.5 dB	—
2.7 Crosstalk Between A & B Channels[H]				
i 40 Hz	48 dB	46 dB	48 dB	
ii 40 Hz to 200 Hz	Oblique segment			
iii 300 Hz to 7.5 kHz	53 dB	50 dB	53 dB	
iv 7.5 kHz to 15 kHz	Oblique segment			
v 15 kHz	48 dB	46 dB	48 dB	
2.8 Phase Difference Between A & B Channels[J]				
i 40 Hz	20°	30°	20°	—
ii 40 Hz to 200 Hz	Oblique segment			
iii 200 Hz to 4 kHz	10°	15°	10°	—
iv 4 kHz to 15 kHz	Oblique segment			
v 15 kHz	20°	30°	20°	—
2.9 Input Balance[K]	—	—	−50 dB	−50 dB
2.10 Output Impedance to PO Lines[L]	600 ohms ±10%	600 ohms ±10%	75 ohms ±10%	600 ohms ±10%
2.11 Output Balance to PO Lines[M]	−50 dB	−50 dB	−50 dB	−50 dB

References to Section 2

A. Gain Adjustment Error. The measurements may be made at any overall gain setting. The PPMs, which are used to control programme output levels of each mixer, will be used as the indicating meters. The gain adjustment error is the difference between the indicated level on a PPM and the actual level at the corresponding output. The measurement should be made at an indicated level of 0 dBu on the stereo channel outputs.

B. Gain Stability. With the input level set constant at —50 dBu for microphone level inputs, or 0 dBu for line level inputs, the stability is defined as the greatest change in output level occurring in one hour.

C. Amplitude-Frequency Response. This measurement may be made at any gain setting up to the maximum available; the output level should be 0 dBu approximately on each output when the measurement is made.

Tests should be made at the following frequencies:— 40 Hz, 60 Hz, 125 Hz, 250 Hz, 500 Hz, 1 kHz, 2 kHz, 4 kHz, 6 kHz, 8 kHz, 10 kHz, 12 kHz, 15 kHz. Additional tests should be made to ensure that the overall response falls off smoothly outside this frequency band.

It should be noted that, as this measurement is a test of the variation of gain of the equipment with frequency, correction should be made for any variation in the input level with frequency.

NB Where OB equipment is used for feeding a PO line or OB radio link of restricted bandwidth, the requirements for frequency response in the range 40 Hz to 15 kHz are relaxed to +1.0/—2.0 dB.

D. Signal/Noise Ratio. The noise measurements may be made under three conditions, and in each case both weighted and unweighted measurements should be made. It should be noted that, in addition to the requirements of Section 2.3, unweighted noise should be less than the corresponding weighted noise by at least the following values:—

70 dB gain condition	4 dB
50 dB gain condition	3 dB
0 dB gain condition	3 dB

For measurements under Section 2.3(i) to (iv), the input should be terminated in 300 ohms; for Section 2.3(v) and (vi), a 600 ohm termination should be used. The noise levels should be measured using a standard PPM (to BS 4297) with the unweighted bandwidth constrained to 20 kHz by a low-pass filter, and with the weighted measurement made using a CCIR network (as defined in Rec. 468-1 Volume X, Geneva 1974). This weighting network should follow the curve shown in Fig. 1.

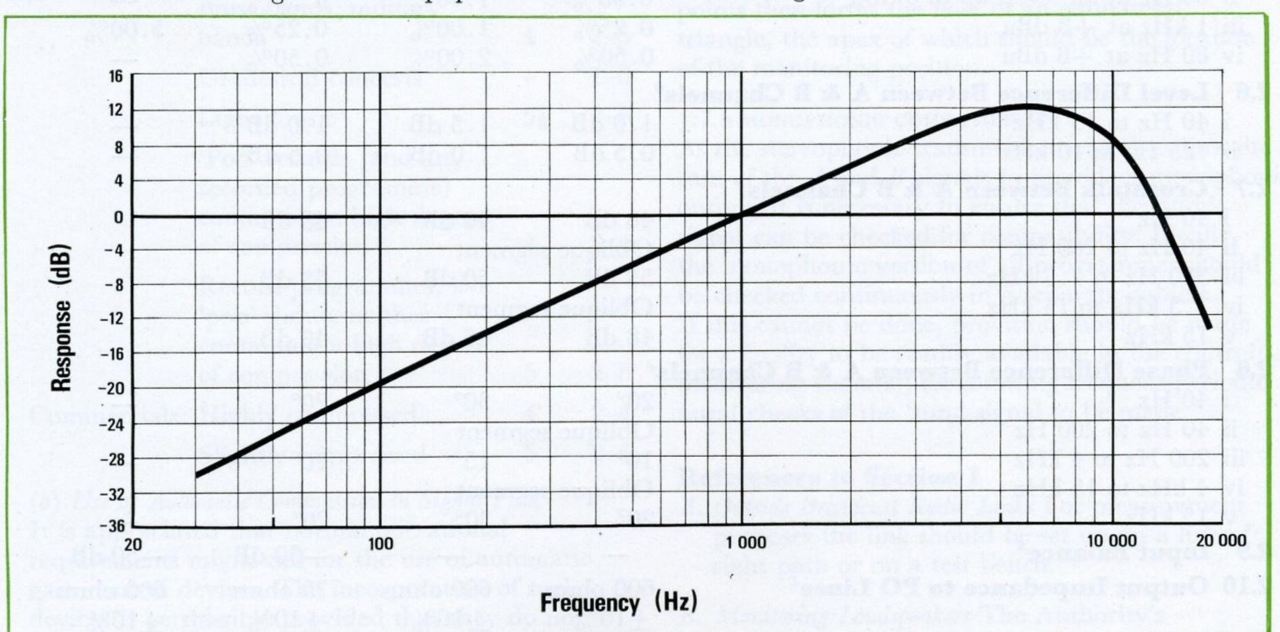


Fig. 1. Amplitude-frequency response characteristic of the weighting network to CCIR Recommendation 468-1.

For all of the input and gain conditions given below, the output level from the chain should be 0 dBu, i.e. a reading of '4' on the measuring PPM. The amplified noise signal also should be made to peak to '4'. The three conditions of measurement are:—

i and ii Input level —70 dBu, output level 0 dBu, with the usual settings for channel, group and main faders (as appropriate), and the balance attenuator set appropriately.

iii and iv Input level —50 dBu, output level 0 dBu. This condition should be achieved by reducing the gain of the mixer in condition (i) and (ii) by 20 dB using in turn each operational control (balance attenuator, channel, group, and main faders as appropriate).

v and vi Input level 0 dBu, output level 0 dBu, with the balance attenuator, channel, group, and main faders set as appropriate.

E. Interchannel Crosstalk. In this context interchannel crosstalk refers to crosstalk between the circuits under test and any dissociated channel in the installation. Measurements should be made as for weighted noise with the necessary additional filtering. The test circuit inputs should be terminated in 300 ohms or 600 ohms, as appropriate, and tone fed to any other input at 50 Hz, 250 Hz, 1 kHz, 6 kHz, 12 kHz and 15 kHz. The gains of the dissociated channels should be adjusted to produce 0 dBu at the appropriate outputs of the mixer, and measurements should be made with these gains set at 70 dB, 50 dB or 0 dB.

F. Harmonic Distortion. Distortion measurements should be made at three different gain settings in order to cover input levels corresponding to dynamic microphones, electrostatic microphones, and line level sources:—

i *a* Input level —70 dBu at 1 kHz, output level 0 dBu, with normal settings for balance attenuator and for channel, group and main faders.

b Input level —50 dBu at 1 kHz, output level 0 dBu, with the same settings for balance attenuator and for group and main faders as in *a* above, the gain being reduced by the channel fader only.

c As in *a* except that input level should be —50 dBu at 1 kHz.

d As in *b* except that input level should be —30 dBu at 1 kHz.

ii Input level —50 dBu at 1 kHz, output level 0 dBu. The input level should then be varied such that the output level changes from —10 dBu to +8 dBu. Measurements should be made at output levels of —10 dBu and +8 dBu.

iii Input level 0 dBu at 1 kHz, output level 0 dBu. The input level should then be varied such that the output level changes from —10 dBu to +8 dBu. Measurements should be made at output levels of —10 dBu, 0 dBu and +8 dBu. This test is not applicable to the worst path.

iv All measurements in i, ii and iii should be repeated at a frequency of 80 Hz.

G. Level Difference Between A and B Channels. This test will be applicable to one of four possible input conditions.

i Microphone input to mono channel – stereo signals derived at a 'pan-pot'.

ii Microphone inputs to stereo channel – stereo circuits throughout chain.

iii Line input to mono channel – stereo signals derived at a 'pan-pot'.

iv Line inputs to stereo channel – stereo circuits throughout chain.

In the case of the mono channels, a test signal (initially at 1 kHz) should be injected, and the 'pan-pot' adjusted to give equal indications on the control PPMs. The variations with frequency of the output levels of the A and B channels should then be measured and the differences calculated. Measurements should be made at the same frequencies as for the Amplitude-Frequency Response test (Ref. *C*). With stereo channels, test signals from a common source (initially at 1 kHz) should be injected into both chain inputs, the chains being lined-up in the normal way. The variations in output level should be measured and the differences calculated. Measurements should be made at the same frequencies as for the Amplitude-Frequency Response test (Ref. *C*).

H. Crosstalk Between A and B Channels. In the case of mono channels, a test signal (initially at 1 kHz) should be injected and the channel routing selector switched such that the signal is fed to only one output. The levels of the wanted signal on this output, and the unwanted signal on the other, should be measured; the difference between these two levels is the crosstalk.

Measurements are made at the following frequencies:—

40 Hz, 250 Hz, 1 kHz, 6 kHz, 12 kHz, 15 kHz.

In the case of stereo channels, a test signal (initially at 1 kHz) should be injected into the input of the A chain, the input of the B chain being terminated in 300 ohms for microphone inputs, or 600 ohms for line inputs. The levels of the wanted and unwanted signals should be measured and the difference (i.e. crosstalk) calculated. Measurements should be made in both directions, at the same frequencies as for mono channels.

J. Phase Difference Between A and B Channels. This test is applicable to one of the four input conditions described in Ref. *G* above.

In the case of the mono channels, the test may be made with the 'pan-pot' set in any position. Measurements should be made at the same frequencies as for the Amplitude-Frequency Response test (Ref. *C*).

K. Input Balance. The measurement should be made as follows, see Fig. 2:—

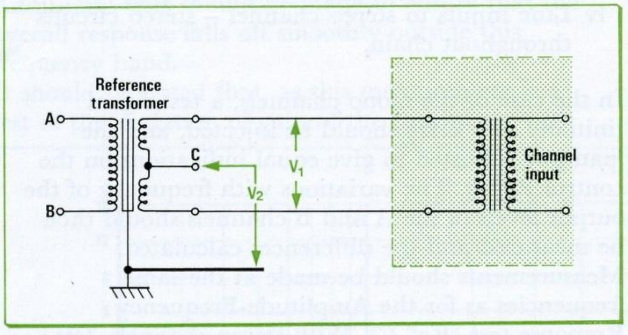


Fig. 2. Method of measuring input balance.

i The reference transformer should have a ratio of 1:1 and an accurate centre-tap (at C) on one winding.

ii An oscillator, set to 10 kHz, should be connected across points A and B, and the input voltage V_1 measured using a high input-impedance instrument. For microphone inputs, the level of V_1 should be —60 dBu approximately; for line-level inputs, V_1 should be 0 dBu. The output voltage level of the chain should be 0 dBu in both conditions.

iii Then, the oscillator should be connected between point C and earth, and a resistance equal to the modulus of the output impedance of the oscillator should be connected between A and B. With microphone channels, the output of the oscillator should be increased until the chain output level is again 0 dBu. The oscillator output voltage should then be measured, using a high input-impedance instrument, to obtain a value for V_2. With line level channels, the output of the oscillator must be increased, but if it is not possible to produce an adequate level the voltage between point C and earth should be measured at the maximum oscillator level available. As the corresponding output voltage under these conditions will be less than 0 dBu, this difference should be noted. Hence, V_2, for line-level channel measurement, will be the sum of the change in oscillator output voltage obtainable and the level difference at the output of the chain.

For both measurements, the

$$\text{input balance} = 20 \log \frac{V_1}{V_2} \text{dB.}$$

L. Output Impedance to PO Lines. A signal, initially at 1 kHz, should be fed into the chain; the output of the chain should be terminated in 600 ohms, and the level across the termination measured using a high input-impedance instrument. The termination should then be removed, the level remeasured and the output impedance calculated for 1 kHz.

To measure the variations in output impedance with frequency, the output should be terminated in 600 ohms; the level across the termination should be measured at frequencies of 50 Hz and 10 kHz. The percentage variation with respect to 1 kHz can then be calculated.

M. Output Balance to PO Lines. The measurement should be made as follows, see Fig. 3:—

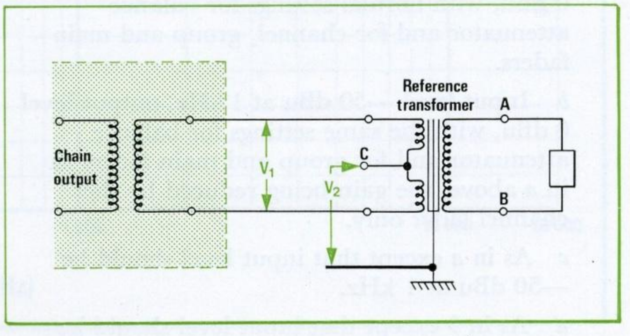


Fig. 3. Method of measuring output balance.

i The reference transformer should have a ratio of 1:1 and an accurate centre-tap (at point C) on one winding.

ii 10 kHz tone at 0 dBu should be fed into a 'line-level' channel input and the chain output voltage level adjusted to be 0 dBu (V_1). The reference transformer should be terminated in an impedance equal to the nominal output termination.

iii The voltage V_2 between point C and earth should then be measured.

The output balance $= 20 \log \frac{V_1}{V_2}$ dB.

iv The measurements of V_1 and V_2 should be made using a high-impedance instrument.

Section 3
OUTSIDE BROADCAST RADIO LINKS

PARAMETER		TOLERANCES
3.1	**Monophonic Circuits**	
a	Output level[A]	0 dBu ±1.0 dB
b	Gain stability[B]	±1.0 dB
3.2	**Amplitude-Frequency Response (wrt 1 kHz)**[C]	
a	40 Hz – 10 kHz	+2.0 / —3.0 dB
b	125 Hz – 8 kHz	±1.0 dB
3.3	**Signal/Noise Ratio**[D]	
	Weighted, random, peak	35 dB*
	Unweighted, random, peak	40 dB
3.4	**Harmonic Distortion**[E]	
a	1 kHz at +8 dBu	2%
b	80 Hz at +8 dBu	2%

*Every endeavour should be made to obtain an improved performance, particularly when the link is intended for use with high-quality programme material.

References to Section 3

A. Output Level. The measurement should be made at the input to the PO line or the contractor's studio equipment using a 1 kHz tone applied at a level of 0 dBu to the transmitter input.

B. Gain Stability. With the input level set constant at 0 dBu, the stability is defined as the greatest change in output level occurring in one hour.

C. Amplitude-Frequency Response. Measurements should be made at the following frequencies:—

40 Hz, 60 Hz, 125 Hz, 250 Hz, 500 Hz, 1 kHz, 2 kHz, 4 kHz, 6 kHz, 8 kHz and 10 kHz.

The input level to the transmitter should be —20 dBu. As this measurement is a test of the variation of gain of the equipment with frequency, correction should be made for any variation in input level with frequency.

D. Signal/Noise Ratio. Both unweighted and weighted measurements should be made using a standard PPM (to BS 4297); the necessary filters are defined in Ref. *D* of Section 2. The input to the transmitter should be terminated in 600 ohms.

E. Harmonic Distortion. The input level to the transmitter should be +8 dBu at both frequencies.

Section 4
MAGNETIC TAPE RECORDERS AND REPRODUCERS

PARAMETER	TOLERANCES		
	REEL-TO-REEL	CARTRIDGE	NEWS REEL-TO-REEL
4.1 Insertion Gain Adjustment Error[A]	±1.0 dB	±1.5 dB	—
4.2 Amplitude-Frequency Response (wrt 1 kHz)[B]			
i 40 Hz to 15 kHz	+2.0 dB/–2.5 dB	+3.5 dB/–2.5 dB	—
ii 125 Hz to 10 kHz	±1.0 dB		±3.0 dB
iii 250 Hz to 10 kHz	—	±1.5 dB	
4.3 Signal/Noise Ratio[C]			
i Weighted, random, peak	40 dB	36 dB	35 dB
ii Unweighted, random, peak	45 dB	40 dB	40 dB
4.4 Harmonic Distortion[D]			
i kHz at +8 dBu	2%	4%	3%
ii 80 Hz at +8 dBu	2%	4%	3%
4.5 Wow and Flutter[E]			
Weighted, peak	0.12%	0.15%	0.40%
4.6 Level Difference Between A & B Channels[F]			
i 40 Hz to 15 kHz	3.0 dB	3.0 dB	—
ii 125 Hz to 10 kHz	1.5 dB	2.0 dB	
4.7 Crosstalk Between A & B Channels[G]			
i 40 Hz to 300 Hz	—6 dB/octave	—6 dB/octave	—
ii 300 Hz to 7.5 kHz	—40 dB	—40 dB	—
iii 7.5 kHz to 15 kHz	+6 dB/octave	+6 dB/octave	—
4.8 Phase Difference Between A & B Channels[H]			
i 40 Hz	60°	—	—
ii 40 Hz to 200 Hz	Oblique segment	—	—
iii 200 Hz to 4 kHz	15°	—	—
iv 4 kHz to 15 kHz	Oblique segment	—	—
v 15 kHz	60°	—	—
vi 50 Hz to 12 kHz	—	90°	—

References to Section 4

A. Insertion Gain Adjustment Error. This error is the difference between the input and output levels at 1 kHz. The measurement should be made with an input level of 0 dBu.

B. Amplitude-Frequency Response. Measurements should be made at the following frequencies:—

40 Hz, 60 Hz, 125 Hz, 250 Hz, 500 Hz, 1 kHz, 2 kHz, 4 kHz, 6 kHz, 8 kHz, 10 kHz, 12 kHz, 15 kHz.

The response should fall off smoothly outside this frequency band. The input level to the recorder should be −20 dBu. As this measurement is a test of the variation of gain of the equipment with frequency, correction should be made for any variation in input level with frequency.

C. Signal/Noise Ratio. Both weighted and unweighted measurements should be made using a standard PPM (to BS 4297); the necessary filters are defined in Ref. *D* in Section 2. The input to the recorder should be terminated in 600 ohms. It should be noted that in addition to the requirements of Section 4.3, where the signal/weighted noise ratio is less than 49 dB, the level of the unweighted noise should be less than that of the weighted noise in accordance with the following table:—

Signal/weighted noise ratio (dB)	40	41	42	43	44	45	46	47	48
Difference between weighted and unweighted noise (dB)	5	4	3	3	3	3	2	1	0

D. Harmonic Distortion. The input level to the recorder should be +8 dBu at both frequencies.

E. Wow and Flutter. Wow and flutter should be measured at a test frequency of 3.15 kHz. The resulting wow and flutter frequencies in the range 200 mHz to 200 Hz should be measured peak weighted using a meter with dynamic characteristics as defined below.

A recorder-reproducer should be measured by recording a 3.15 kHz test frequency, and by subsequently reproducing this recording and measuring the total wow and flutter. Only in the case of tape delay machines should wow and flutter be measured while simultaneously recording and reproducing.

The measuring equipment should comply with CCIR Recommendations 409-2, the relevant sections of which are reproduced below:—

i Weighting Network
The weighting network should have a response which follows the curve shown in Fig. 4.

ii Dynamic Characteristics of the Meter
For short uni-directional deviations of the frequency of measurement (rectangular pulses of duration A) with a repetition rate of 1 Hz, the meter should indicate the percentage B of the reading obtained with a sinusoidal frequency-modulation of 4 Hz having a peak-to-peak deviation equal to the frequency swing of the pulse, as shown in the table below. The return time should be such that, when applying pulses of 100 ms duration with a repetition rate of 1 Hz, the meter should indicate (40±10)% between pulses.

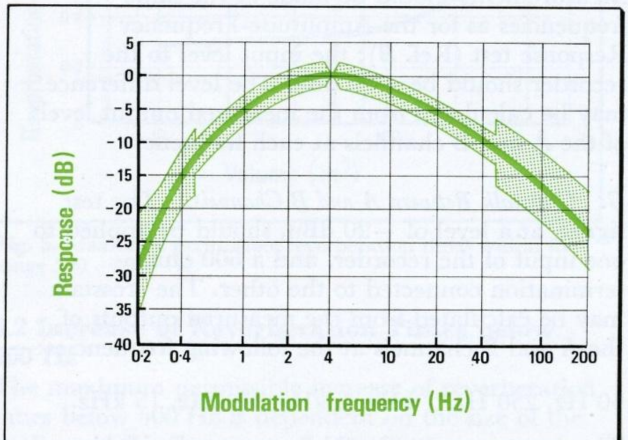


Fig. 4. Amplitude-frequency response characteristic of the weighting network to CCIR Recommendation 409-2.

iii Indication
The meter should measure peak-to-peak values, but the reading should indicate the wow in per cent (%) of the figure corresponding to one half the peak-to-peak value.

Duration of impulse, A, (ms)	10	30	60	>100
Indication, B, (%)	21±3	62±6	90±6	100±5

F. Level Difference Between A and B Channels. Measurements should be made at the same frequencies as for the Amplitude-Frequency Response test (Ref. *B*); the input level to the recorder should be −20 dBu. The level difference may be calculated from the measured output levels of the A and B channels at each frequency.

G. Crosstalk Between A and B Channels. The test signal, at a level of −20 dBu, should be applied to one input of the recorder, and a 600 ohm termination connected to the other. The crosstalk may be calculated from the measured outputs of the A and B channels at the following frequencies:—

40 Hz, 250 Hz, 1 kHz, 6 kHz, 12 kHz, 15 kHz.

The measurements should be repeated with the input signals reversed.

H. Phase Difference Between A and B Channels. The input signal should be at a level of −20 dBu. Where the phase difference is not constant, the maximum value will be taken as the measurement.

Section 5
SIGNAL SOURCES
5.1 Disc Reproducers[A]

PARAMETER	TOLERANCES
5.1.1 AMPLITUDE-FREQUENCY RESPONSE (wrt 1 kHz)[B]	
40 Hz to 12.5 kHz	±2.5 dB
5.1.2 SIGNAL/NOISE RATIO[C]	
(i) Weighted, random, peak	50 dB
(ii) Unweighted, random, peak	55 dB
5.1.3 RUMBLE[D]	
(i) Weighted	55 dB
(ii) Unweighted	40 dB
5.1.4 INTERMODULATION DISTORTION[E]	
	1.0%
5.1.5 WOW AND FLUTTER[F]	
Weighted, peak	0.12%
5.1.6 LEVEL DIFFERENCE BETWEEN A AND B CHANNELS[G]	
40 Hz to 12.5 kHz	1.5 dB
5.1.7 CROSSTALK BETWEEN A AND B CHANNELS[H]	
40 Hz	12.5 dB
40 Hz to 300 Hz	Oblique segment
300 Hz to 4 kHz	20 dB
4 kHz to 12.5 kHz	Oblique segment
12.5 kHz	12.5 dB
5.1.8 PHASE DIFFERENCE BETWEEN A AND B CHANNELS[J]	
40 Hz	40°
40 Hz to 200 Hz	Oblique segment
200 Hz to 4 kHz	20°
4 kHz to 12.5 kHz	Oblique segment
12.5 kHz	36°

5.2 Microphones

Programme contractors should seek approval from Quality Control Section of the IBA for all types of microphone for programme use.

References to Section 5

A. Disc Reproducers. Where appropriate, the performance tolerances include a chain comprising a pick-up head and an equalising amplifier.

B. Amplitude-Frequency Response. Measurements should be made when replaying the mono side of a test record to BS 1928:1965 at the following frequencies:—

40 Hz, 63 Hz, 80 Hz, 125 Hz, 250 Hz, 500 Hz, 1 kHz, 2 kHz, 4 kHz, 6.3 kHz, 8 kHz, 10 kHz, 12.5 kHz.

C. Signal/Noise Ratio. Both weighted and unweighted measurements should be made using a standard PPM (to BS 4297) and with the turntable

running and the pick-up arm on its own rest. The necessary filters are defined in Ref. *D* of Section 2. The noise levels should be measured relative to the output derived from a peak cutting velocity of 10 cm/s at 1 kHz.

D. Rumble. Both weighted and unweighted measurements should be made using an indicating instrument as defined in BS 4852 (Part 1): 1972. The necessary filters also are defined in that document. The tests should be made while replaying a test record to DIN 45544.

E. Intermodulation Distortion. Measurements should be made while replaying side B of a test record to DIN 45542.

F. Wow and Flutter. Measurements should be made while replaying a test record to DIN 45545. The instrument used should have weighting and indicating characteristics as defined in Ref. *E* to Section 4.

G. Level Difference Between A and B Channels. The A and B channel gains should be adjusted to give equal output levels at 1 kHz, and the level difference should be calculated for each frequency (as for Amplitude-Frequency Response tests Ref. *B*) from the measured outputs of the A and B channels using the mono side of a test record to BS 1928:1965.

H. Crosstalk Between A and B Channels. The crosstalk should be calculated for the frequencies given below from the measured outputs of the A and B channels, using the stereo side of a test record to BS 1928:1965:—

40 Hz, 250 Hz, 1 kHz, 6.3 kHz, 12.5 kHz.

J. Phase Difference Between A and B Channels. Measurements should be made using the mono side of a test record to BS 1928:1965 as the signal source.

Section 6
ACOUSTICS
6.1 Reverberation Time[4]

In general, for a studio of given volume the maximum permissible reverberation time over the frequency range 500 Hz to 2 kHz is shown in Fig. 5, but a reverberation time approximately 10% less than that obtained from this curve should be taken as a design criterion. Times for adjacent octave bands within the range 250 Hz to 4 kHz should not differ by more than 10%. These reverberation times are also applicable to quality check rooms.

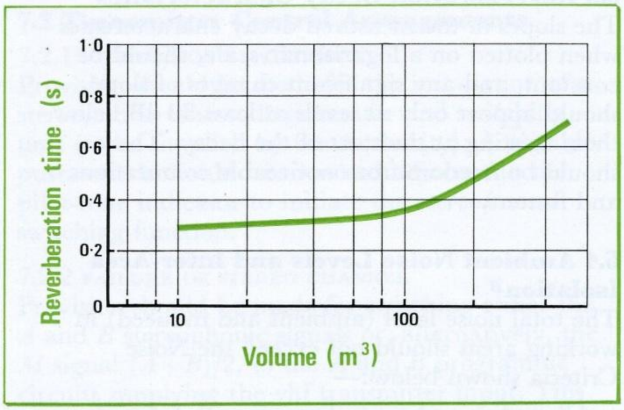


Fig. 5. Maximum permissible reverberation times within the range 500 – 2000 Hz.

6.2 Increase of Reverberation Times below 500 Hz

The maximum permissible increase of reverberation times below 500 Hz is dependent on the size of the studio and the frequency. In Fig. 6, the appropriate limits for small studios (up to 120 m³) are shown as percentage increases. These increases are referred to '100%' which is taken as the highest *measured* reverberation time in the range 500 Hz – 2 kHz. For studios greater than 120 m³, the low frequency rise should be reduced to the extent that, with

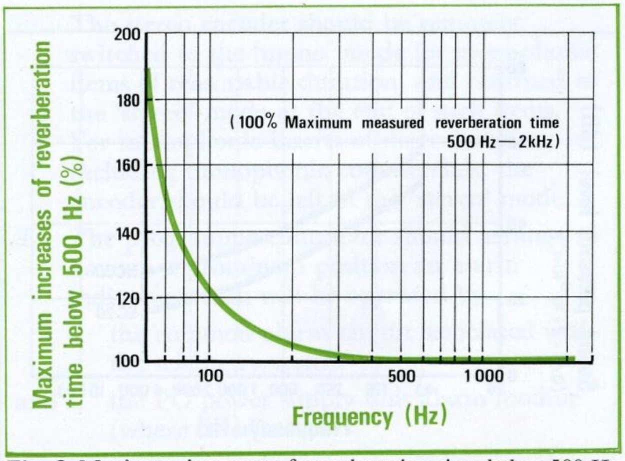


Fig. 6. Maximum increases of reverberation time below 500 Hz for talks studios and small studies up to 120m³. (100% = maximum measured reverberation time within the range 500 – 2000 Hz).

studios greater than 300 m³, no increase at low frequencies is permissible.

6.3 Reverberation Decay Characteristics

The slopes of the measured decay characteristics when plotted on a logarithmic scale, should be constant, and any significant changes of slope should appear only at levels at least 30 dB below those existing at the start of the decay. There should be freedom from noticeable colourations and flutters.

6.4 Ambient Noise Levels and Inter-Area Isolation[B]

The total noise level (ambient and induced) in working areas should not exceed the Noise Criteria shown below:—

All studios and control rooms with 'on-air' capability, including normal stand-by areas	NC 20
Quality check rooms and control rooms without 'on-air' capability. Announcer booths using the 'close microphone' technique where the maximum microphone distance is 30 cm	NC 30

The appropriate criteria are shown in Fig. 7. The figures quoted should be achieved at any time, with normal lighting, ventilation plant and any other ancillary equipment fully operational, and with the normal operating environment in adjacent areas. To test the isolation between adjacent areas, interfering signals having the spectra shown in

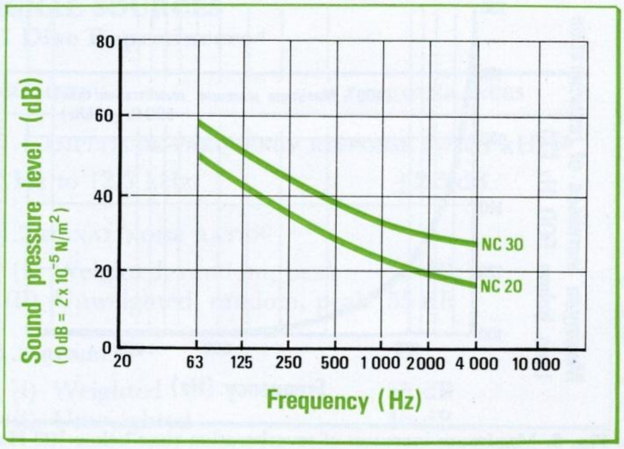


Fig. 7. Noise criteria – the values shown should be achieved at any time under normal operational conditions and with the normal operating environment in adjacent areas.

Fig. 8 should be used as appropriate. The minimum value of N for each of the octave bands 63 Hz to 500 Hz will be taken as follows:—

Talks studios, corridors (including communal sound locks), office and reception areas	70 dB
Control rooms, presentation studios and quality check rooms	80 dB
Music studios	100 dB

The same criteria should be satisfied under conditions of normal impulsive interference.

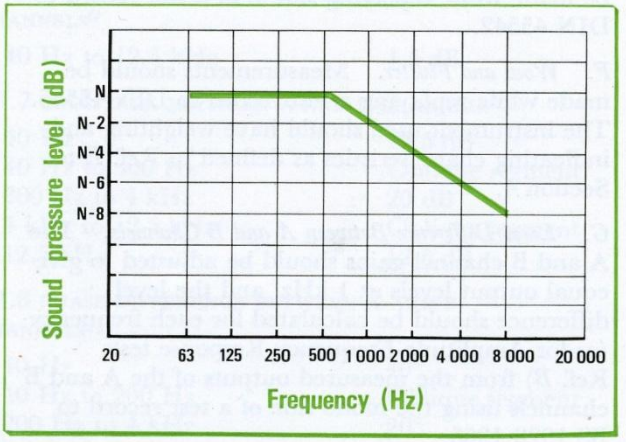


Fig. 8. Normalised sound spectrum for interfering signals.

References to Section 6

A. Reverberation Time. Reverberation is defined as the time taken for the mean square sound pressure in the enclosure, having initially been sustained long enough to reach a steady state, to decay 60 dB after the sound has ceased. It is a constant at any particular frequency for any particular studio. The values over the required frequency range are usually measured by arranging for some form of visual presentation of the decaying signal so that the (normally) exponential decay is shown as a straight line, the slope of which can then be measured. If a single steady tone is used as a source, mutual interference effects between the components of the reflected sound during the decay can produce very irregular slopes, and it is therefore standard practice to use bands of frequencies as a sound source. Reverberation times will be measured by using octave bands of filtered noise except at low frequencies when third octaves will be used. In each octave band, the result quoted will be the

arithmetical average of several (preferably up to five) readings.

In accordance with BS 3638, the decay will normally be measured over a range of 30 dB. The resultant figure will be doubled to determine the reverberation time.

B. Ambient Noise Levels and Inter-Area Isolation. Measurements of noise (ambient, interfering and/or induced) will be made using a precision sound level meter and an octave band analyser conforming to the standards specified by IEC 197 (Precision Sound Level meters) and IEC 225 (Band-pass Filters). Wherever possible at least five measurements should be made in each area in each octave band; the arithmetical average of the sound pressure levels should be quoted for each octave band. For impulsive interference tests, the precision sound level meter should be used with its indicating section operating under the 'fast' attack and decay characteristics.

Section 7
BROADCAST SYSTEM OPERATIONAL REQUIREMENTS

7.1 System Monitoring Requirements

7.1.1 RECEIVING INSTALLATIONS
Professional receiving equipment, together with associated aerial systems, should be installed to provide a high-fidelity stereophonic output from the vhf transmissions, together with a satisfactory audio output from the mf transmissions, for monitoring purposes.

7.1.2 RECORDING OF VHF AND MF TRANSMISSIONS
Arrangements should be made for the entire output of both the vhf and mf stations to be simultaneously recorded on ¼ inch magnetic tape. The tape format for this purpose should be based upon a 4-channel system in one direction, at a tape speed of 15/16 inch per second. Tracks Nos 1 and 3 should be used for the stereo vhf service, Track No. 2 for the mono mf service and timing signals should be recorded on Track No. 4. The recorded material should be retained for 13 weeks and should be made available to the Authority, on request, at short notice.

7.1.3 STEREO/MONO STATUS INDICATION
Provision should be made by the programme contractor for the pilot-tone detector of the vhf monitoring receiver to initiate indication of the stereophonic or monophonic status of the transmitter encoder. This indication should be clearly displayed to the duty operator at all times.

7.2 Transmitter Control Arrangements

7.2.1 STEREO/MONO SWITCHING
Provision should be made for the installation of a stereo/mono tone-code generator and switching unit (to be supplied by the Authority). A suitable push-switch should be mounted adjacent to the pilot-tone indicator to initiate the stereo/mono switching function.

7.2.2 FAILURE OF STEREO CHANNEL
Provision should be made for switching either the A and B stereophonic signals or, alternatively, the M signal $(A+B)/2$, to the A and B programme circuits supplying the vhf transmitter input. This switching will enable an emergency programme feed to be maintained should either of the two stereo programme circuits fail.

7.3 Operational Procedures

The Authority requires that the following operational procedures should be implemented at ILR studio centres:—

a Normal monitoring of the received output of the vhf transmission should be carried out in accordance with the foregoing sections.

b Frequent checks must be made of the technical quality of the compatible monophonic mf transmission.

c The stereo encoder should be remotely switched to the 'mono' mode for monophonic items of reasonable duration, and returned to the 'stereo' mode at the end of such items. For monophonic inserts of short duration, including monophonic commercials, the encoder should be left in the 'stereo' mode.

d The programme contractor should arrange to have in a prominent position an alarm indicator which will be operated by
   i the common alarm circuit associated with the telemetry system
and ii the PO power supply unit alarm module (where fitted).

e When the stereo/mono status indication shows that the transmitter encoder has switched automatically to the 'mono' mode, due to a

fault, the M signal $(A+B)/2$ should be routed to the A and B circuits feeding the vhf transmitter. Action should then be taken to diagnose and localise the fault in accordance with standing instructions.

f When a transmitting station fault is detected, the Authority's maintenance service should be advised in accordance with the procedures agreed with IBA Station Operations and Maintenance Department.

g The programme contractor should provide suitable networks for equalising telephone circuits which are at any time to be used for the live broadcasting of telephone calls. The programme contractor should meet the requirements of the Post Office Corporation relating to the broadcasting of programme material derived from Post Office telephone circuits.

Specification of Independent Local Radio Broadcasting Standards

Synopsis
A number of high-quality Independent Local Radio services have been established in the UK. These were planned by the IBA on the basis that eventually they would be available in a total of about 60 ILR areas, but so far only 19 have been authorised by the Government and these operate in 18 different areas (London having two). In each area there is a frequency-modulated, stereophonic service on vhf, and a bandwidth-limited monophonic version of this is also available on mf.

This specification should be read in conjunction with the IBA Code of Practice for Independent Local Radio Studio and Outside Broadcast Performance which details the standards that have been established for ensuring that adequate technical quality is maintained, and that the transmissions comply with national and international regulations.

Section 1 deals with the mf service. Particular reference is made to the limited audio bandwidth, the use of compression, the modulation standards employed and the service area. Section 2 gives details of the vhf service and includes an explanation of the pilot-tone stereophonic system. It also provides information on the frequency-modulation standards, pre-emphasis, the service area, polarisation and the handling of monophonic signals.

Introduction

The Independent Local Radio service of the IBA is a high-quality broadcasting system. It is essentially a frequency-modulated vhf service incorporating stereophonic capability, with a bandwidth-limited mf service in each area. The standards adopted for studio centres, lines and transmitters are based upon CCIR recommendations. They may be revised from time to time to take account of changes in technology and to comply with national or international requirements.

The studio centres are normally connected to the associated vhf transmitters by Post Office stereophonic circuits consisting of pairs of lines having equivalent characteristics and having the required immunity from mutual crosstalk. However, in a few cases the stereophonic signals are conveyed by radio links.

The *A* and *B* signals are encoded at the vhf transmitter site using the 'pilot-tone' system. A compatible monophonic version of the studio output is obtained by addition of the *A* and *B* signals at the studio centre. A music circuit, which complies with PO Tariff 'M' standards, carries this monophonic signal to the associated mf transmitter site. The individual studio centres throughout the country are linked by an inter-city network, using PO circuits which comply with Tariff 'M' standards to provide a monophonic system.

Section 1
STANDARDS OF THE MF BROADCASTING SYSTEM

1.1 Basic Characteristics

The Independent Local Radio mf service has been provided to back up what is essentially a high-quality vhf system. It was necessary to establish a duplicate mf service to cater for the large number of homes and private vehicles which are not equipped with vhf receivers.

Use of the congested mf band introduces the attendant problems of adjacent-channel and co-channel interference. The situation is aggravated by daily and seasonal changes in propagation conditions. These problems have been obviated as

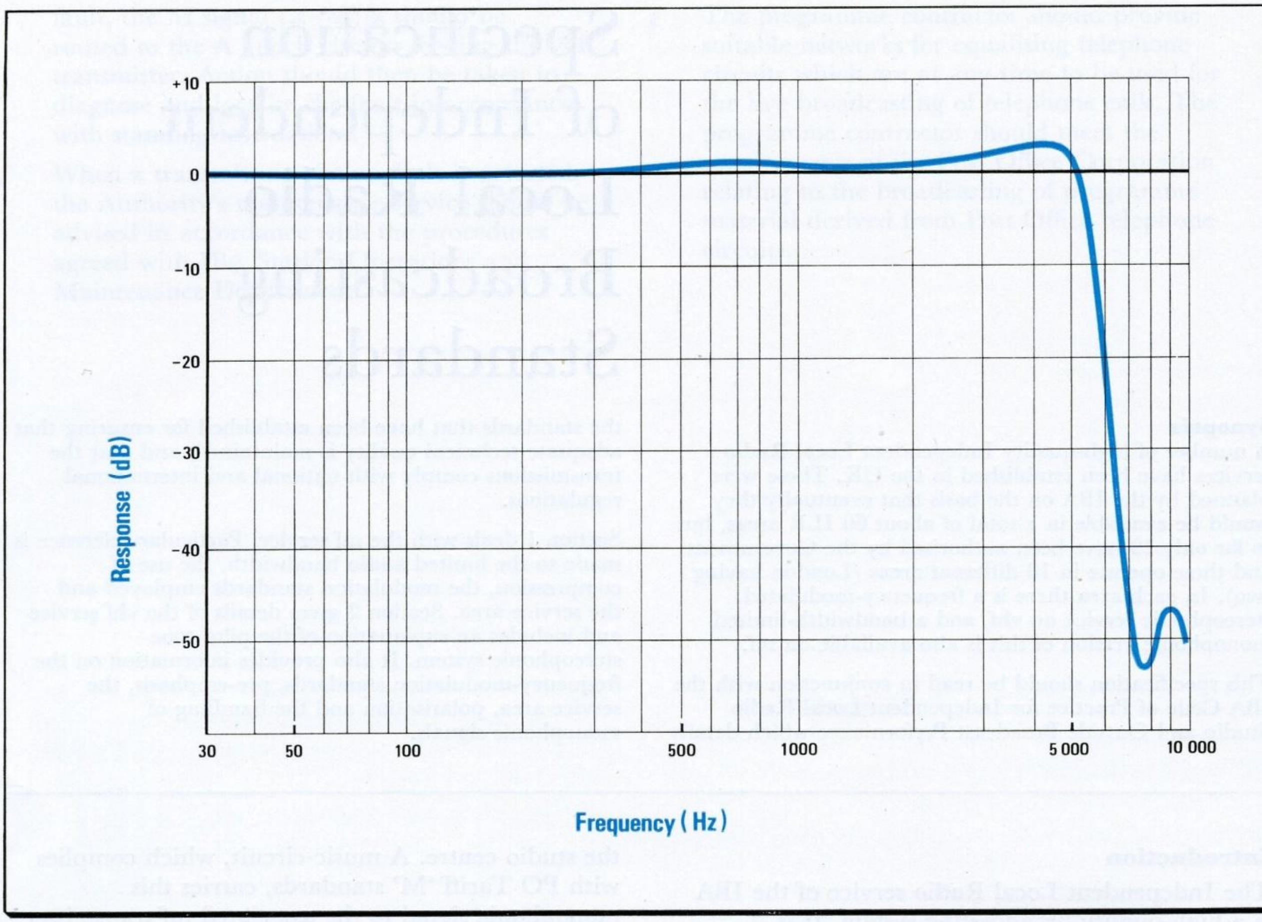


Fig. 1. Response of a typical filter used for limiting the bandwidth of ILR mf transmissions.

far as possible. The system uses amplitude modulation, and the bandwidth of the audio frequency spectrum is limited in accordance with the filter characteristics shown in Fig. 1. A considerable degree of volume compression is used.

The mf transmitter sites have been carefully selected to give coverages which match the vhf service areas as closely as possible. Transmitter power levels vary from area to area to meet local requirements.

The mf service does not provide a stereophonic capability, nor can it take advantage of the full bandwidth of the studio output. Nevertheless, it has been established that the compatible 'sum' signal provides a reasonable representation of the original programme, and that acceptable technical quality can be achieved despite the limitations mentioned above.

1.2 Characteristics of the Audio Signals

1.2.1 AUDIO FREQUENCY BANDWIDTH

The overall audio-frequency bandwidth for Independent Local Radio mf monophonic transmissions is principally determined by low-pass filters located at each mf transmitter site. Figure 1 shows the frequency response of a typical filter.

1.2.2 STUDIO CENTRES AND OUTSIDE BROADCAST EQUIPMENT

The requirements for the technical performance of Independent Local Radio studio centres and OB equipment are detailed in the appropriate Code of Practice contained in this volume.

1.2.3 COMPRESSION

Volume compression of 12 dB is provided by a limiter/compressor unit located at each mf transmitter site. The characteristics of this

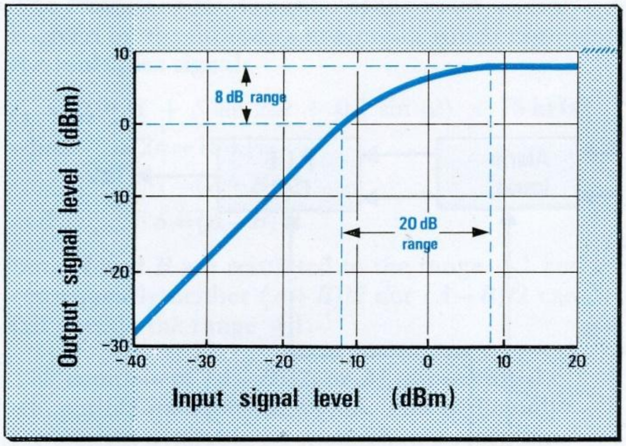


Fig. 2. The mf transmitter compression characteristic.

compression, shown in Fig. 2, are such that a dynamic input range of 20 dB, from −12 dBm to +8 dBm, will produce a dynamic output range of 8 dB, from 0 dBm to +8 dBm. Input signal levels above +8 dBm will produce an output level limited to +8 dBm. The attack time is 1 ms, and the recovery time is automatically adjusted in accordance with the duration of limiting action. Recovery speeds are rapid for isolated peaks but comparatively slow for sustained high-level signals.

1.2.4 PROGRAMME LINES
Lines to mf transmitters conform with PO Tariff 'M' standards.

1.3 Amplitude Modulated MF Radio Frequency System

1.3.1 TRANSMISSION BAND
Independent Local Radio mf transmitters operate within the frequency band 525 to 1,605 kHz.

1.3.2 CHANNEL BANDWIDTH
The nominal bandwidth for each mf transmission channel is 9 kHz.

1.3.3 MODULATION STANDARDS
Amplitude modulation is employed, using double-sideband transmission. Both positive and negative peaks of the modulated envelope waveform are limited to a maximum of 90%. The modulating frequency band is specified as in Section 1.2.1.

Transmitter line-up conditions are such that an audio level of 0 dBm at the transmitter input produces 35.8% modulation. Consequently, an input level of +8 dBm will produce 90% modulation. A block diagram of the transmitter input arrangements is shown in Fig. 3 in which the main and stand-by signal paths are shown in full line, and the supervisory, alarm and control elements are shown dotted.

1.3.4 CARRIER FREQUENCY STABILITY
The carrier frequency stability should be within the limits ±10 Hz from the nominal frequency.

1.3.5 CARRIER LEVEL STABILITY
The carrier level should not vary by more than ±5% from its unmodulated level under any condition of modulation.

1.3.6 POLARISATION
Vertical polarisation is used.

1.3.7 SERVICE AREA
The service area of each mf station is intended to coincide as far as possible with that of the associated vhf station in respect of monophonic reception. In general, an mf service area meeting this requirement is delineated by a contour representing a field strength of 3 mV/m. The principal aim has been to provide a field strength in town and city centres which is adequate for satisfactory reception on portable receivers and car radios. Some stations using the two UK assigned frequencies 1151 kHz and 1546 kHz, make use of directional aerial systems to achieve optimum coverage. Since all the ILR mf stations use shared frequencies, the coverage after dusk is less than the day-time service area by reason of sky-wave interference from other stations.

1.3.8 LINE OR EQUIPMENT FAILURE
No stand-by programme lines are provided between ILR studio centres and the associated mf transmitting stations. Failure of a programme line, or the associated station equipment, initiates automatic change-over to a stand-by chain which is supplied with the local programme from a vhf receiver. The performance of the receiving installation is such that no significant reduction in technical quality is experienced.
Failure of the main transmitter or the main rf drive unit initiates automatic change-over to stand-by equipment. The stand-by transmitter will take over the service within 20 s of a failure of the main equipment.

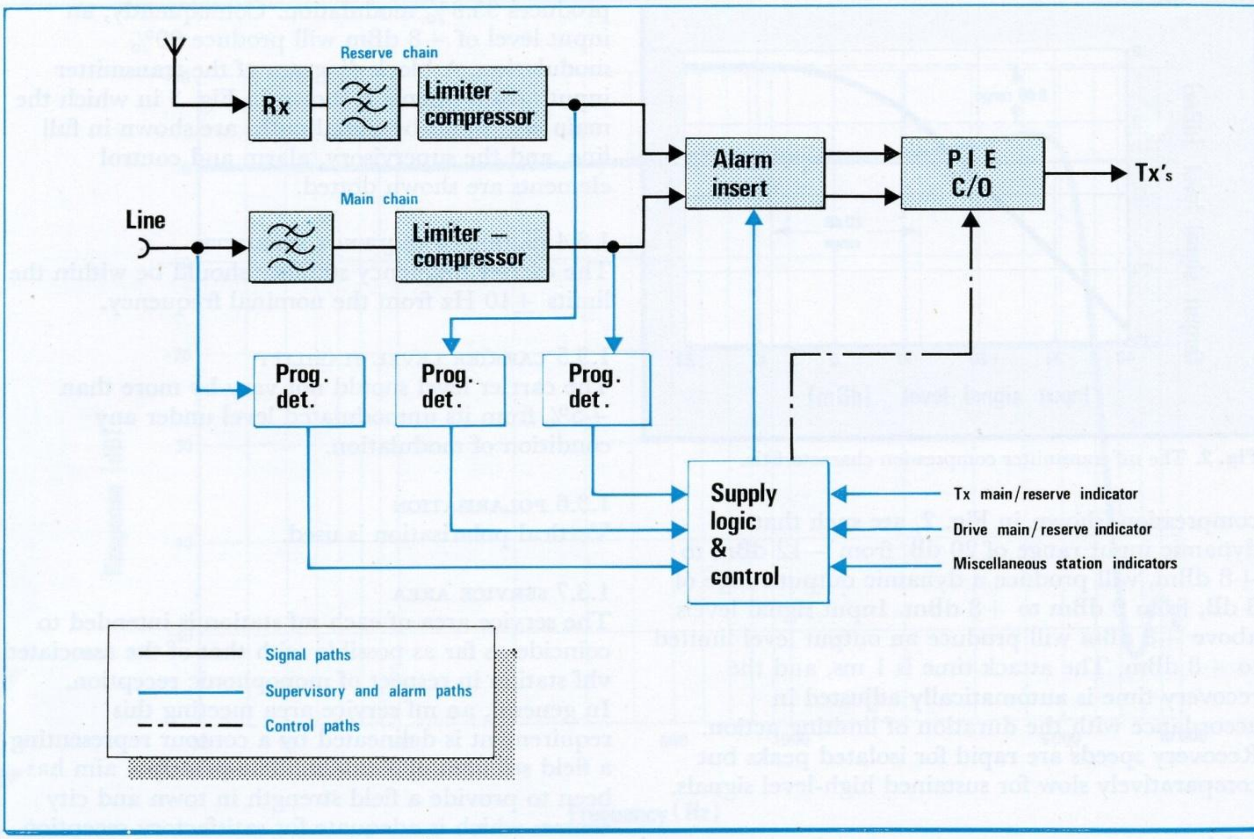


Fig. 3. Input arrangements at an mf transmitter.

Section 2
STANDARDS OF THE VHF STEREOPHONIC BROADCASTING SYSTEM
2.1 Basic Characteristics

The Independent Local Radio vhf service employs the pilot-tone system defined by CCIR Recommendation 450 (Vol X, Geneva 1974). This system is compatible in that satisfactory monophonic reception of stereophonic transmissions can be achieved using normal monophonic receivers, and furthermore, that suitable stereophonic receivers can satisfactorily receive vhf monophonic transmissions.

The pilot-tone system makes use of the multiplex technique whereby two separate audio signals are broadcast by suitable modulation of a single transmitter. The signals intended for the left-hand and right-hand loudspeakers are referred to as the *A* and *B* signals respectively. The terms *A* and *B* may be considered as being proportionally representative of the voltages present at any particular instant in the two separate audio channels.

The compatible signal, *M*, equal to one half the sum of *A* and *B*, produces a deviation of the main carrier not exceeding 90% of the maximum permissible deviation of 75 kHz. A separate signal, *S*, equal to one half the difference between *A* and *B*, is used to obtain the sidebands of an amplitude-modulated, suppressed sub-carrier of frequency 38 kHz. The sum of these sidebands produces a peak deviation of the main carrier equal to that which would be produced if the signal *S* were applied in place of the *M* signal, i.e. not more than 90% of the maximum permissible deviation of 75 kHz. A pilot-tone signal of frequency equal to 19 kHz, i.e. one half that of the suppressed sub-carrier, is arranged to produce a deviation of the main carrier of between 8% and 10% of the maximum. The *A* and *B* signals are each subject to pre-emphasis with a time constant of 50 μs prior to encoding.

The instantaneous deviation of the main carrier is given by the following expression which represents the multiplex signal:

$$f_d = 0.9(M + S \sin 2\omega t + 0.1 \sin \omega t) \times 75 \text{ kHz}$$

where $\omega/2\pi = 19$ kHz

$M = (A+B)/2$

and $S = (A-B)/2$

Both A and B are restricted to the range ± 1 and consequently neither $(A+B)/2$ nor $(A-B)/2$ can fall outside the range ± 1.

The component $(A+B)/2$, or M, represents the compatible monophonic signal. This is the only component available for monophonic reception. The component $(A-B)/2$, or S, represents the difference signal. It enables a stereophonic receiver to separate the A and B signals since $M+S=A$ and $M-S=B$. The phase relationship between the pilot tone and the suppressed sub-carrier may be discerned from the above expression for f_d. It is such that, when modulating the transmitter with a multiplex signal for which A is positive and $B=-A$, this signal crosses the time axis with a positive slope each time the pilot signal has an instantaneous value of zero. A positive value of the multiplex signal corresponds with a positive deviation of the main carrier. The pilot tone is readily filtered out at the receiver and used in regenerating the 38 kHz sub-carrier, thus allowing recovery of the S signal.

Since the values of A and B are each restricted to ± 1, the expression for f_d cannot exceed the range ± 75 kHz which is the requirement for maximum deviation of the main carrier.

2.2 Characteristics of the Audio Signals

2.2.1 AUDIO-FREQUENCY BANDWIDTH

The audio-frequency bandwidth for Independent Local Radio vhf stereophonic and monophonic transmissions is specified as being from 40 Hz to 15 kHz.

2.2.2 COMPRESSION

No volume compression is introduced in the audio signal paths between studio centre outputs and the vhf transmitters, but, at the transmitting stations, limiters are provided in both the A and B programme chains to prevent the transmitter deviation exceeding ± 75 kHz after pre-emphasis.

2.2.3 STUDIO CENTRES AND OUTSIDE BROADCAST EQUIPMENT

The requirements for the technical performance of Independent Local Radio studio centres and OB equipment are detailed in the appropriate Code of Practice contained in this volume.

2.2.4 PROGRAMME LINES

The stereophonic programme circuits rented from the Post Office are maintained to the following limits:—

PARAMETER	TOLERANCES
Amplitude-Frequency Response with Reference to 1 kHz	
a 40 Hz to 14 kHz	+0.5 to −1.0 dB
b 125 Hz to 10 kHz	±0.5 dB
c 14 kHz to 15 kHz	+0.5 to −2.0 dB
Signal-to-Crosstalk Ratio between A and B Channels	56 dB
Level Difference between A and B Channels	
a 40 Hz to 14 kHz	1.0 dB
b 125 Hz to 10 kHz	0.5 dB
c 14 kHz to 15 kHz	3.0 dB
Phase Difference between A and B Channels	
a 40 Hz	18°
b 40 Hz to 200 Hz	oblique segment
c 200 Hz to 4 kHz	9°
d 4 kHz to 15 kHz	oblique segment
e 15 kHz	18°
Harmonic Distortion at +8 dBm, 100 Hz and 1 kHz	0.3%
Signal/Noise Ratio (peak, CCIR Weighted)	57 dB

2.3 Encoding of the Audio Signals for Stereophonic Transmission

2.3.1 THE PILOT-TONE SYSTEM

The fm vhf stereophonic Independent Local Radio service makes use of the pilot-tone system as defined by CCIR Recommendation 450 (Vol. X, Geneva 1974). The basic characteristics of this system are described in Section 2.1.

2.3.2 ENCODERS

The encoders are situated at the vhf transmitter sites and form part of the station programme input

equipment. They are supplied with the A and B signals from the associated studio centre, and their function is to provide the multiplex signal described in Section 2.1. Figure 4 shows a block diagram of an encoder, and Fig. 7 shows the position of an encoder in a programme chain.

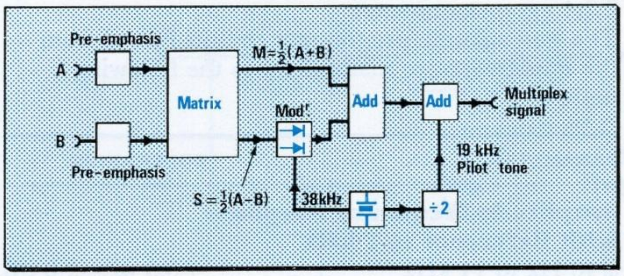


Fig. 4. Block diagram of a sterophonic encoder.

2.3.3 A AND B SIGNALS

The instantaneous voltages of the signals intended for the left-hand and right-hand loudspeakers are proportionally represented by the terms A and B respectively. During the programme transmission such signals are normally of a complex nature, but, with sinusoidal inputs to each programme chain, the following relationships will apply:

$$A = A_{\max} \sin(pt + \phi)$$
$$B = B_{\max} \sin(qt + \theta)$$

where $\frac{p}{2\pi}$ and $\frac{q}{2\pi}$ are the frequencies present in the A and B chains respectively, and ϕ and θ are the phase relationships of the two signals with reference to $t = 0$.

The nominal bandwidth required to accommodate these two signals is specified as being from 40 Hz to 15 kHz, and, in the input stages of the encoder, each signal is subject to pre-emphasis with a time constant of 50 ± 2 μs. This pre-emphasis characteristic is illustrated in Fig. 5.

2.3.4 SUM AND DIFFERENCE SIGNALS

M Signal

One component of the multiplex output supplied by the encoder is designated the M signal. This component constitutes the compatible monophonic version of the combined input to the encoder. It comprises a voltage of instantaneous values equal to one half the sum of the pre-emphasised A and B signals, hence, $M = (A+B)/2$.

The maximum amplitude of this component must not produce a deviation of the main carrier greater than 67.5 kHz, i.e. 90% of 75 kHz.

S Signal

A second component of the multiplex output from the encoder is designated the S signal and equals one half the difference between the pre-emphasised

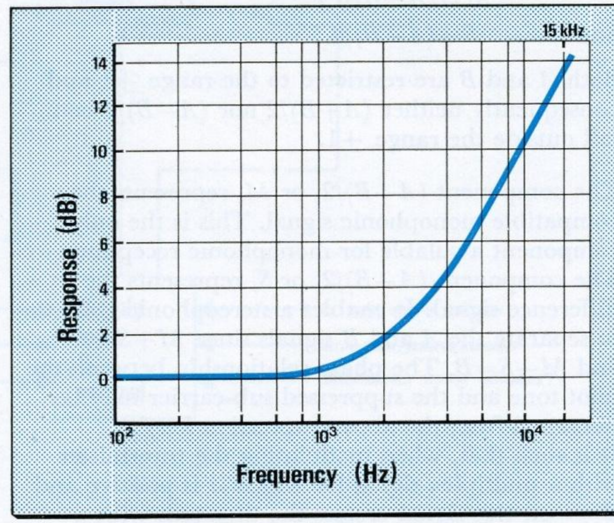


Fig. 5. Pre-emphasis characteristic (t=50 s).

A and B signals, hence, $S = (A-B)/2$. The S signal is used to obtain the sidebands of an amplitude-modulated, suppressed sub-carrier. The maximum amplitude of the sum of these sidebands is restricted to the same level as is the maximum amplitude of the M signal, i.e. it must not produce a deviation of the main carrier in excess of 67.5 kHz.

2.3.5 SUPPRESSED SUB-CARRIER AND STEREOPHONIC SUB-CHANNEL SIGNALS

The suppressed sub-carrier referred to above has a frequency of 38 kHz $\pm$ 4 Hz. (This frequency stability is approximately equivalent to one part in 10^4). Ideally, the residual sub-carrier amplitude at the encoder output should be zero, but, in any event, should never be sufficient to produce a deviation of the main carrier greater than 1% of maximum, i.e. any resulting deviation must not exceed 750 Hz.

The lower and upper sidebands of the stereophonic sub-channel are contained within the specified frequency ranges 23.0 to 37.96 kHz, and 38.04 to 53.0 kHz respectively.

2.3.6 PILOT-TONE SIGNAL

A third component of the multiplex encoder output

consists of a pilot-tone signal of 19 kHz $\pm$ 2 Hz, i.e. precisely half the frequency of the suppressed sub-carrier, which should be phase-locked to the sub-carrier within the limits of $\pm 3°$. This signal should be of constant amplitude and should produce a deviation of the main carrier of 9% $\pm$1% of the maximum, i.e. 6.75 kHz $\pm$ 750 Hz.

2.3.7 ENCODER SIGNAL LEVELS AND TRANSMITTER DEVIATION

The instantaneous deviation of the main carrier is given by the expression previously quoted in Section 2.1:

$f_d = 0.9(M + S \sin 2\omega t + 0.1 \sin \omega t) \times 75$ kHz.

The spectral distribution of the multiplex signal is shown in Fig. 6.

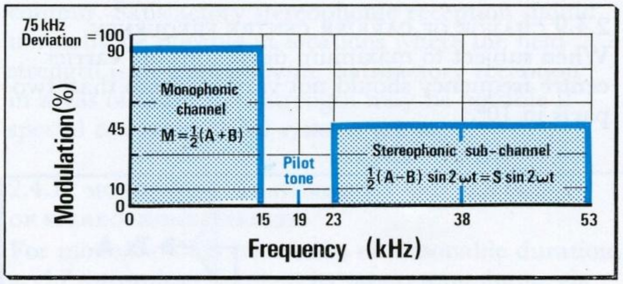


Fig. 6. The spectral distribution of the multiplex signal.

The transmitter is set such that with the pilot tone removed and with single-tone signals at frequencies below the onset of the pre-emphasis characteristic applied at a level of 0 dBm to either the A or B channel alone, the peak deviation shall be 21.55 kHz $\pm$ 500 Hz.

With the input signals removed and the pilot tone applied, the deviation of the main carrier should be 6.75 kHz $\pm$ 750 Hz, as already stated.

If, now, the input signals, as previously specified, be increased to a level of +8 dBm, the peak deviation with the pilot tone present will be approximately 61 kHz. Since the maximum permissible deviation is 75 kHz, these line-up conditions provide a guard band of approximately 2 dB to accommodate higher modulation levels resulting from the pre-emphasis of frequencies above 400 Hz. In practice, limiters have been incorporated in the programme input equipment chain to prevent the transmitter input level exceeding +10 dBm at any frequency.

It was stated earlier that the terms *A* and *B* may be considered as being proportionally representative of the instantaneous voltages present in the two audio channels, and that both quantities are restricted to the range of $\pm$1. The actual relationship between the values of *A* and *B* and the audio signal levels depends upon the point of measurement and the line-up conditions. For the conditions given above, the instantaneous values of *A* and *B* to be used in the expression for the deviation of the main carrier will be 0.29 times the corresponding instantaneous voltages at the 600 ohm input terminals of the encoder.

2.3.8 LIMITERS

Limiters are provided in the A and B programme chains at the vhf transmitting stations immediately preceding the stereophonic encoder inputs. These limiters do not introduce compression at normal signal levels but are set to prevent the transmitter input level exceeding +10 dBm at any frequency. The positions of these limiters in a programme chain are shown in Fig. 7.

The *A* and *B* limiters are cross-connected in such a manner that limiting action in either unit will modify the gain in the other by the amount necessary to maintain the original relationship between the *A* and *B* signal levels, thus avoiding unwanted stereophonic image shift.

The attack time is 1 ms. The recovery time is automatically adjusted in accordance with the duration of the limiting action. Recovery speeds are rapid for isolated peaks but comparatively slow for sustained high-level signals.

2.4 Frequency Modulated VHF Radio Frequency System: Stereophonic and Monophonic Transmissions

2.4.1 TRANSMISSION BAND

Independent Local Radio vhf transmitters operate within the frequency band 88.1 to 97.5 MHz.

2.4.2 CHANNEL BANDWIDTH

The nominal bandwidth for each vhf transmission channel is 250 kHz.

2.4.3 CHANNEL SEPARATION

While, taking the UK as a whole, the channel separation is 100 kHz, the aim has been to achieve a channel separation within any particular locality of at least 800 kHz. Separation between channels in adjacent localities is at least 300 kHz.

2.4.4 MAXIMUM FREQUENCY DEVIATION

The maximum deviation produced by frequency modulation of the main carrier should be $\pm$75 kHz.

2.4.5 MODULATING FREQUENCY BAND
The modulating frequency band is specified as being from 40 Hz to 53 kHz.

2.4.6 MODULATION LEVELS
The specification for the main carrier deviation produced by the stereophonic multiplex signal is contained in Section 2.3.

For monophonic transmission, when the *A* and *B* signals are identical, the audio input level to the vhf transmitting station is 3 dB below the level of the corresponding 'sum' signal. This arises from the fact that for monophonic transmission the programme level is controlled using the 'sum' PPM which reads 3 dB higher than the *A* and *B* PPMs. It has been established that this standard of operation introduces no significant change in subjective loudness when changing from stereophonic to monophonic programmes. Since the audio input level is reduced by 3 dB, the effective guard band for monophonic transmission is 5 dB with pilot tone present, or 6 dB without pilot tone.

Figure 7 shows a block diagram of the transmitter input arrangements. The main signal paths are shown in full line and the supervisory, alarm and control elements are shown dotted.

2.4.7 PRE-EMPHASIS OF THE AUDIO SIGNALS
For both monophonic and stereophonic transmissions the audio input signals will be subject to pre-emphasis using a time constant of 50 μs ± 2 μs.

2.4.8 CARRIER FREQUENCY STABILITY
The carrier frequency stability should be within two parts in 10^5, i.e. approximately ±2 kHz.

2.4.9 CHANGE OF CARRIER CENTRE FREQUENCY
When subject to maximum deviation, the carrier centre frequency should not vary by more than two parts in 10^6.

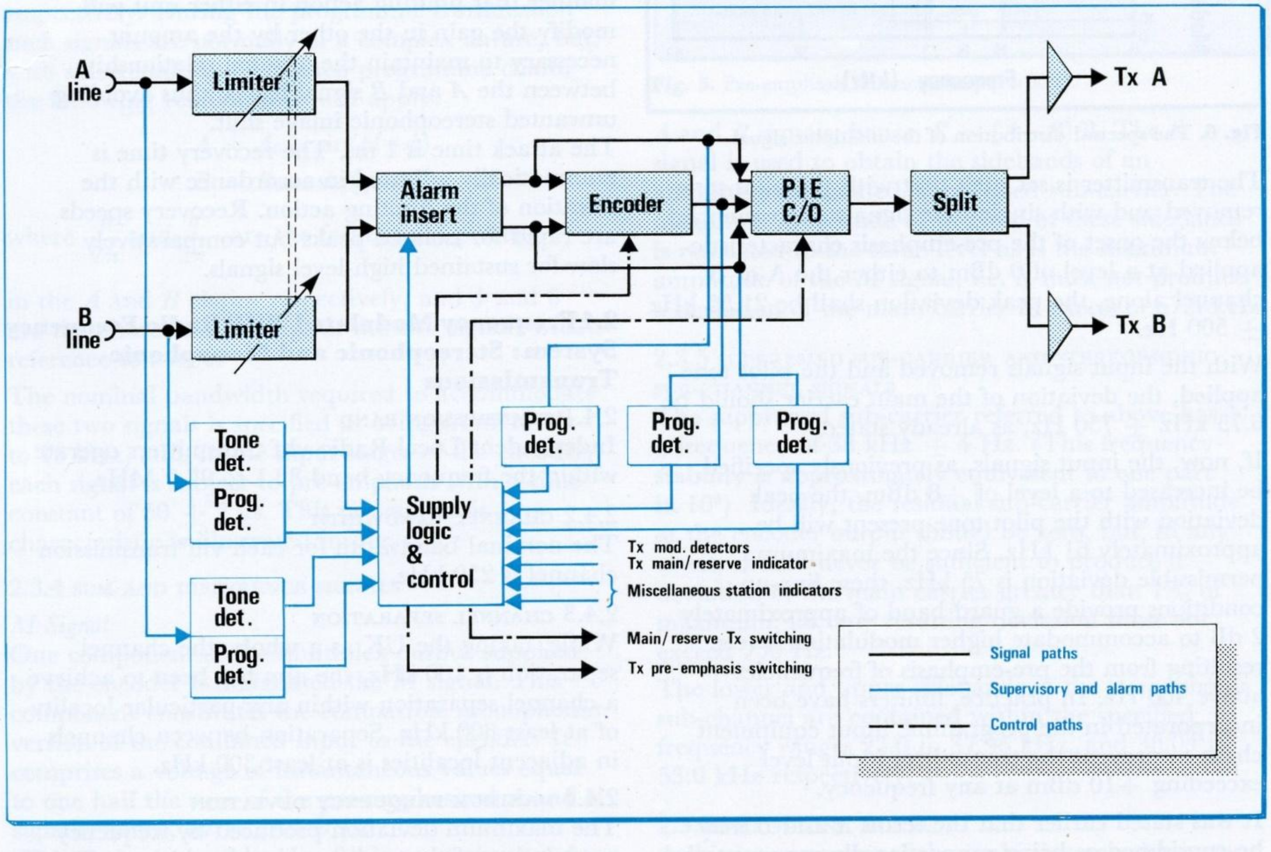


Fig. 7. Input arrangements of a vhf transmitter.

2.4.10 POLARISATION

A full treatment of this subject is included in *IBA Technical Review* 5. Polarisation of the Independent Local Radio vhf transmissions will normally be circular. In certain cases slant or horizontal polarisation may be necessary because of mast limitations and/or aerial design difficulties. The circular polarisation uses 'left-hand' (anti-clockwise) rotation as observed from the receiving aerial when facing the transmitter. The slant polarisation is 45° anti-clockwise from the horizontal as observed from the receiving aerial when facing the transmitter.

2.4.11 SERVICE AREA

The service area for monophonic reception is normally considered to be within the 1 mv/m contour. Satisfactory stereophonic reception should normally be possible at locations where the field strength is at least 2 mv/m. Satisfactory reception in areas of lower field strength may be possible if special receiving aerial systems are used.

2.4.12 MONOPHONIC TRANSMISSIONS AND FAILURE OF STEREOPHONIC CIRCUITS

For monophonic transmission of reasonable duration, a vhf transmitter receives its programme input via the encoder in the normal monophonic mode. To achieve this, the encoder shown in Fig. 7 is switched by remote control from the studio centre. The reason for operating the vhf transmitters in the monophonic mode during monophonic programmes of reasonable duration is to improve the signal-to-noise ratio at the output of stereophonic receivers. The improvement results from removal of the noise contribution of the stereophonic sub-channel. With the standards adopted by the Authority, the signal-to-noise ratio is increased by a theoretical maximum of approximately 18 dB.

Any failure of the A and B lines or limiters, or the stereo encoder, will be automatically detected and will initiate the switching of the change-over unit to the remaining serviceable circuit. At the same time, the studio operator will be made aware of the fault condition in order that the monophonic signal may be switched to both the A and B lines.

2.4.13 FAILURE OF TRANSMITTERS

Failure of the main transmitter or the main rf drive unit initiates automatic change-over to stand-by equipment. The stand-by transmitter will take over the service within between 20 seconds and 3½ minutes of a failure of the main equipment, depending upon the type of installation.

Specification of Standards for Broadcast Teletext Signals

Synopsis
This specification describes the parameters of the Teletext signals transmitted in the United Kingdom by the BBC and the Independent Television networks. It was published jointly by the British Broadcasting Corporation, the Independent Broadcasting Authority and the British Radio Equipment Manufacturers' Association in September 1976 and supersedes all earlier versions. The BBC uses the name CEEFAX and the Independent Television Companies use the name ORACLE for their public information services. The technical specifications of the ORACLE and CEEFAX signals are identical.

Based on experience gained in the initial years of the transmissions, changes have been made since the first specification was published in October 1974. Additional Control Characters have been allocated to provide facilities which can be used to enhance the display of information. These changes have been made in such a way that future transmissions remain compatible with Teletext decoders based on the later specification dated 13 January 1976.

Distortions, noise and spurious signals inevitably degrade the signal to a greater or less extent. An important point to note is that an increase in magnitude of these effects will cause a gradual deterioration in analogue television while a digital signal, such as Teletext, can still be decoded until the disturbances exceed a critical level. Field studies have confirmed that in almost all cases this critical level for Teletext occurs when television reception is already poor.

Introduction

This specification defines the Teletext broadcasting system. Much of the detailed information is carried by figures and tables. The description is in four sections.

The first section describes how binary code groups are formed into Data-Lines for inclusion in the television field-blanking interval.

The second section describes how the control and address information carried on each Data-Line, together with the special Page-Header Data-Lines and the sequence of transmission of the Data-Lines, allow the Data-Lines corresponding to the Rows of a selected Page to be identified.

The third section describes how the Character Codes received on the Data-Lines corresponding to the Rows of the selected Page are interpreted to give the Page display.

The fourth section defines Teletext terms.

Certain patent applications have been made in connection with equipment designed to operate to this Specification.

The main technical features of the system are:

a The Teletext system is an information broadcasting system in which Pages of text and graphical symbols are transmitted in coded form on otherwise unused television lines during the field interval.

b The decoded Pages are intended to be displayed in place of, or added to, the television picture. Newsflashes and Subtitles may be inset in the picture.

c The system uses binary signalling at 6.9375 Mbits/s during each Data-Line. It is directly applicable to 625/50 television systems with video bandwidths of 5.0MHz or greater.

d Each Data-Line carries data synchronising and address information and the codes for a Row of 40 characters.

e A Page comprises 24 Rows of 40 characters, including a special top Row called the Page-Header.

f The Page-Header has additional address and control information in place of the first eight characters to identify the Page itself and to control its display. The remaining 32 characters include eight reserved for the display of clock-time.

g The address and control codes use eight-bit Hamming Codes to convey four message bits, permitting single errors to be corrected at the receiver. The seven-bit character codes have an odd-parity bit added permitting single errors to be detected at the receiver.

h Using two Data-Lines per field the system allows four full Pages per second to be transmitted.

i Unoccupied Rows of a Page need not be transmitted.

j Up to eight Magazines, each having up to 100 Pages, may be transmitted. Any of these Pages may be selected by the user.

k Up to 3,200 versions of each Page may be transmitted and selected by a four-digit Time Code. This is not necessarily related to clock-time.

l Control Characters are provided to:

i select one of seven Display Colours
ii select one of eight Background Colours
iii display selected characters with Double Height
iv cause selected characters to Flash
v Conceal selected characters until Revealed by the user.

Section 1
TELEVISION DATA-LINES

The television signal includes unused lines in the field blanking interval, see Fig. 1, to allow time for field flyback in receivers before each active field begins. The duration of this interval is usually 25 lines, and some of the later lines are used by broadcasters for test and signalling purposes.

This system can use any of these unused lines as Data-Lines. Initially lines 17(330) and 18(331) are being used but other lines may be used.

A line in the field blanking interval is identified as a Teletext Data-Line by the presence of the Clock Run-In (see Section 1.2.1) followed by the Framing Code (see Section 1.2.2) at an appropriate time.

1.1 Data-Line Waveform

Each Data-Line contains binary elements (bits) as a two-level NRZ (Non-Return-to-Zero) signal, suitably shaped by a filter.

1.1.1 DATA LEVELS

The binary signalling levels are defined on a scale where television black level is 0% and white level 100%, see Fig. 2. The binary '0' level is then 0($\pm$2)% and the binary '1' level is 66($\pm$6)%. The difference between these levels is the basic

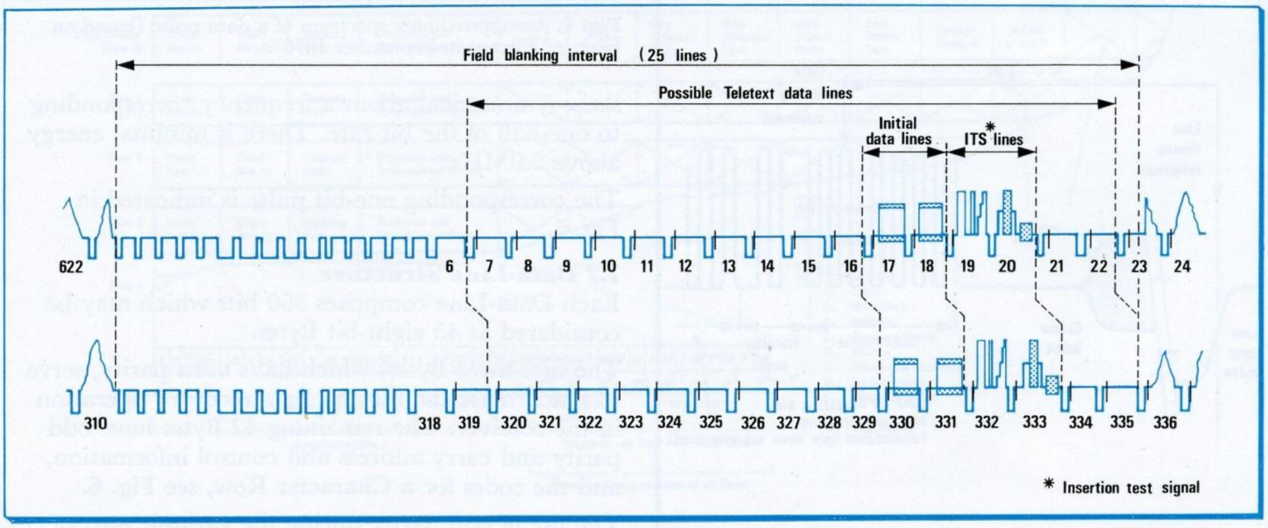


Fig. 1. Teletext Data-Lines.

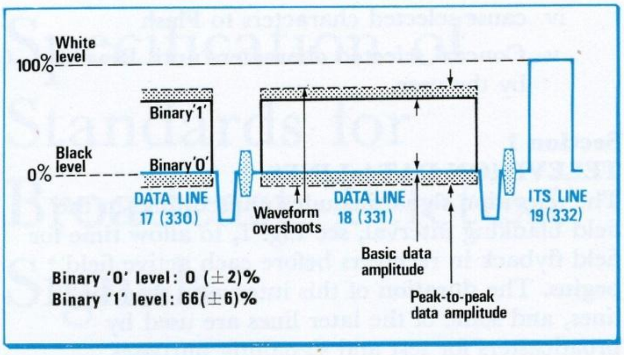


Fig. 2. Data levels.

data amplitude. The data waveform will contain overshoots so the peak-to-peak data amplitude will exceed the basic data amplitude.

The basic data amplitude may vary from Data-Line to Data-Line.

1.1.2 BIT RATE

The binary element signalling rate is 6.9375 Mbit/s (±25 parts per million).

It is 444 times the nominal television line frequency.

1.1.3 DATA TIMING

The data timing reference point is the peak of the penultimate '1' of the Clock Run-In sequence, see Fig. 3. This point has been selected to reduce the effect of any transient distortions at the start of the Data-Line.

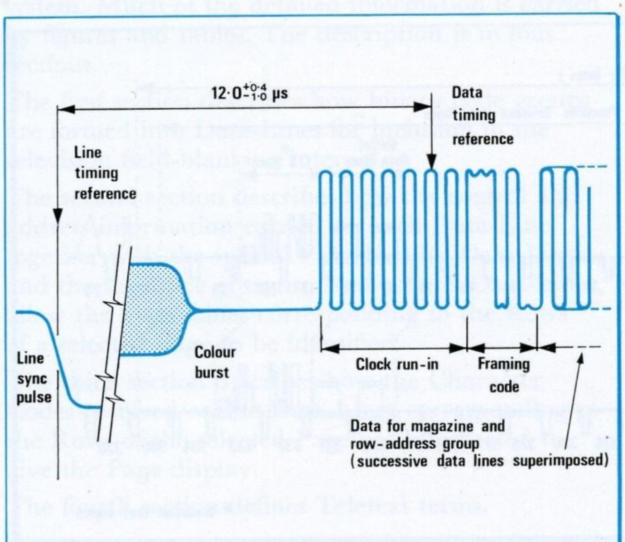


Fig. 3. Data timing.

The line time reference is the half-amplitude point of the leading edge of the line synchronising pulse. The data timing reference in the signal as transmitted shall be 12.0 (+0.4/−1.0) µs after the line time reference.

The data timing may vary from Data-Line to Data-Line.

1.1.4 DATA PULSE SHAPE

The spectrum of the generated data pulses, which is the product of the spectrum of the basic NRZ data waveform and that of a phase-corrected shaping filter, is indicated in Fig. 4. To minimise intersymbol interference the spectrum is substantially

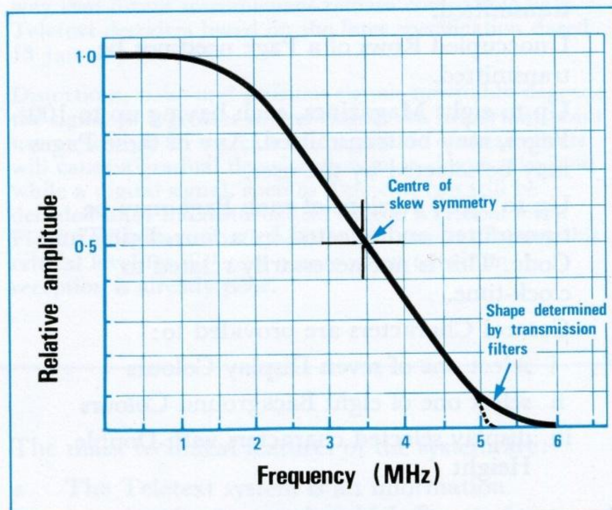


Fig. 4. An approximate spectrum of a data pulse (based on practice current in September 1976).

skew-symmetrical about a frequency corresponding to one-half of the bit rate. There is minimal energy above 5.0MHz.

The corresponding one-bit pulse is indicated in Fig. 5.

1.2 Data-Line Structure

Each Data-Line comprises 360 bits which may be considered as 45 eight-bit Bytes.

The first three Bytes, which have even parity, serve to synchronise the bit and Byte recovery operation in the receiver. The remaining 42 Bytes have odd parity and carry address and control information, and the codes for a Character Row, see Fig. 6.

The use of odd parity during the variable part of the Data-Line ensures that there are never more

than 14 bit periods between the data level transitions in the waveform. This simplifies the recovery of the bit-rate clock directly from the data waveform.

All the address and Page control information is transmitted using Hamming Code Bytes to reduce the possibility of the wrong Character Rows being stored in the receiver.

1.2.1 CLOCK RUN-IN

The first two Bytes of every Data-Line comprise the Clock Run-In sequence of alternating bits, beginning 101010...., to indicate the presence of a Data-Line and to establish the timing of the bits on that line, see Fig. 6.

In some circumstances the first one or two binary '1's may be absent.

1.2.2 FRAMING CODE

The third Byte of every Data-Line comprises the Framing Code 11100100. This code has been selected to enable Byte synchronisation to be established even if one bit of the Framing Code has been wrongly received.

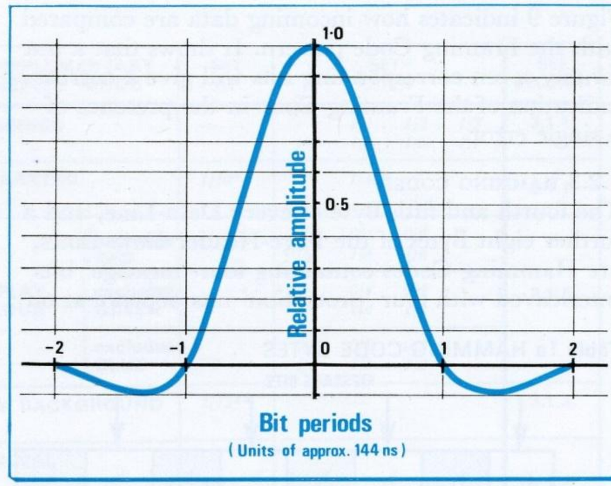


Fig. 5. An approximate one-bit data pulse (based on practice current in September 1976).

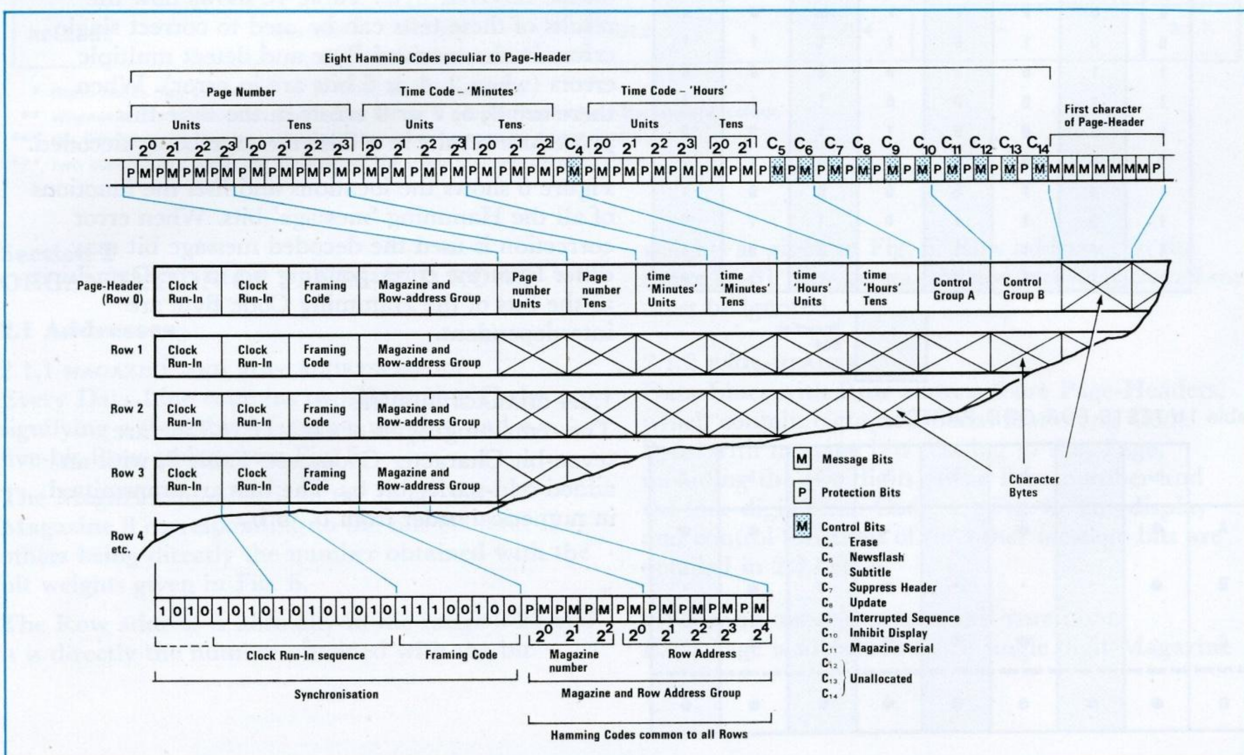


Fig. 6. Synchronisation and Hamming Codes at start of Page-Header and Row transmissions.

Figure 9 indicates how incoming data are compared with the Framing Code pattern. It shows that a test for any seven corresponding bits will give a correct indication of the Framing Code in the presence of a single error.

1.2.3 HAMMING CODES

The fourth and fifth Byte of every Data-Line, and a further eight Bytes of the Page-Header Data-Lines, are Hamming Codes containing four 'message' bits interleaved with four 'protection' bits dependent on

Table 1a HAMMING CODE BYTES

b_8 (message bit)	b_7 (protection bit)	b_6 (message bit)	b_5 (protection bit)	b_4 (message bit)	b_3 (protection bit)	b_2 (message bit)	b_1 (protection bit)
0	0	0	1	0	1	0	1
0	0	0	0	0	0	1	0
0	1	0	0	1	0	0	1
0	1	0	1	1	1	1	0
0	1	1	0	0	1	0	0
0	1	1	1	0	0	1	1
0	0	1	1	1	0	0	0
0	0	1	0	1	1	1	1
1	1	0	1	0	0	0	0
1	1	0	0	0	1	1	1
1	0	0	0	1	1	0	0
1	0	0	1	1	0	1	1
1	0	1	0	0	0	0	1
1	0	1	1	0	1	1	0
1	1	1	1	1	1	0	1
1	1	1	0	1	0	1	0

MESSAGE BITS: b_8, b_6, b_4, b_2

Protection Bits: b_7, b_5, b_3, b_1 (shaded)

Table 1b TESTS FOR ODD PARITY

	b_8	b_7	b_6	b_5	b_4	b_3	b_2	b_1
A	●		●				●	●
B	●				●	●	●	
C			●	●	●		●	
D	●	●	●	●	●	●	●	●

● Tested bits

Table 1c DECODING ACTION

RESULTS OF PARITY TESTS A, B, C	D	INFERENCE	ACTION
All Correct	Correct	no errors	accept message bits
All Correct	Not Correct	error in b_7	accept message bits
Not all Correct	Correct	multiple errors	reject message bits
Not all Correct	Not Correct	single error	refer to Table 1b to identify error. Correct error if in message bit.

the message bits as listed in Table 1a. The bits are transmitted in numerical order from b_1 to b_8.

Table 1b details four parity tests that can be made on the received Byte. Table 1c shows how the results of these tests can be used to correct single errors in the received Byte and detect multiple errors (when 2, 4 or 6 bits are in error). When there are 3, 5, 7 or 8 errors in the Byte this procedure results in a false message being decoded.

Figure 6 shows the locations and lists the functions of all the Hamming 'message' bits. When error correction is used the decoded message bit may differ from the corresponding bit in the Data-Line as the bits of the Hamming Code Byte are interdependent.

1.2.4 CHARACTER BYTES

The remaining Bytes of each Data-Line are seven-bit Character Codes, see Table 3, with an added odd-parity bit b_8. The bits are transmitted in numerical order from b_1 to b_8.

Table 2 DISPLAY MODES AND CONTROL CHARACTERS

DISPLAY MODE	SET AT	SET AFTER	COMPLEMENTARY DISPLAY MODE	SET AT	SET AFTER	SEE SECTION
ALPHANUMERICS	*Row Start*	0/1 0/2 0/3 0/4 0/5 0/6 0/7	GRAPHICS		1/1 1/2 1/3 1/4 1/5 1/6 1/7	3.1.1.
CONTIGUOUS	*Row Start* 1/9*	1/9*	SEPARATED	1/10*	1/10*	3.1.1.
DISPLAY COLOUR includes RED	*Row Start*	0/1 0/3 0/5 0/7 1/1 1/3 1/5 1/7	DISPLAY COLOUR excludes RED	—	0/2 0/4 0/6 1/2 1/4 1/6	3.1.2.
DISPLAY COLOUR includes GREEN	*Row Start*	0/2 0/3 0/6 0/7 1/2 1/3 1/6 1/7	DISPLAY COLOUR excludes GREEN	—	0/1 0/4 0/5 1/1 1/4 1/5	3.1.2.
DISPLAY COLOUR includes BLUE	*Row Start*	0/4 0/5 0/6 0/7 1/4 1/5 1/6 1/7	DISPLAY COLOUR excludes BLUE	—	0/1 0/2 0/3 1/1 1/2 1/3	3.1.2.
BLACK BACKGROUND	*Row Start* 1/12	—	NEW BACKGROUND	1/13**	—	3.1.3.
REVEAL	*Row Start User Control****	0/1 0/2 0/3 0/4 0/5 0/6 0/7 1/1 1/2 1/3 1/4 1/5 1/6 1/7	CONCEAL	1/8	—	3.1.4.
STEADY	*Row Start* 0/9	—	FLASH	—	0/8	3.1.4.
UNBOXED	*Row Start* 0/10****	0/10****	BOXED	0/11****	0/11****	3.1.5.
NORMAL HEIGHT	*Row Start* 0/12	—	DOUBLE HEIGHT	—	0/13	3.1.6.
RELEASE	*Row Start*	1/15	HOLD	1/14	—	3.1.7.

* these codes may take effect 'at' or 'after' their occurrence,

** whenever this code occurs the Display Colour is adopted as the New Background colour,

*** the Reveal mode may be maintained throughout a page by a user control,

**** two consecutive codes are transmitted, the mode changes between them.

Section 2
ORGANISATION OF PAGES AND ROWS

2.1 Addresses

2.1.1 MAGAZINE AND ROW ADDRESS GROUP

Every Data-Line contains two Hamming Codes signifying a three-bit Magazine number and a five-bit Row address, see Fig. 6.

The Magazine number is in the range 1-8, Magazine 8 corresponding to the bits 000 and the others being directly the number obtained with the bit weights given in Fig. 6.

The Row address is normally in the range 0-23 and it is directly the number obtained with the bit weights as given in Fig. 6. Row addresses in the range 24-31 may be transmitted but such Data-Lines must be ignored.

2.1.2 PAGE-HEADER

Data-Lines with Row address 0 are Page-Headers, which contain eight additional Hamming Code Bytes with message bits relating to that Page, including the two digits of the Page number and the four-digit Time Code, see Fig. 6. The display and control functions of the other message bits are detailed in 2.3 below.

2.1.3 PAGE IDENTIFICATION AND TIME CODE

Each Page is identified by its single digit Magazine

Table 3 TELETEXT CHARACTER CODES

b_7						0	0	0	0	0	0	1	1	1	1	1	1
b_6						0	0	1	1	1	1	0	0	1	1	1	1
b_5						0	1	0	0	1	1	0	1	0	0	1	1
Bits	b_4	b_3	b_2	b_1	Col / Row	0	1	2	2a	3	3a	4	5	6	6a	7	7a
	0	0	0	0	0	NUL ①	DLE ①			0		@	P	—		p	
	0	0	0	1	1	Alpha^n Red	Graphics Red	!		1		A	Q	a		q	
	0	0	1	0	2	Alpha^n Green	Graphics Green	"		2		B	R	b		r	
	0	0	1	1	3	Alpha^n Yellow	Graphics Yellow	£		3		C	S	c		s	
	0	1	0	0	4	Alpha^n Blue	Graphics Blue	$		4		D	T	d		t	
	0	1	0	1	5	Alpha^n Magenta	Graphics Magenta	%		5		E	U	e		u	
	0	1	1	0	6	Alpha^n Cyan	Graphics Cyan	&		6		F	V	f		v	
	0	1	1	1	7	Alpha^n ② White	Graphics White	'		7		G	W	g		w	
	1	0	0	0	8	Flash	Conceal Display	(		8		H	X	h		x	
	1	0	0	1	9	Steady ②	Contiguous ② Graphics	)		9		I	Y	i		y	
	1	0	1	0	10	End Box ②	Separated Graphics	*		:		J	Z	j		z	
	1	0	1	1	11	Start Box	ESC ①	+		;		K	←	k		¼	
	1	1	0	0	12	Normal ② Height	Black ② Background	,		<		L	½	l		‖	
	1	1	0	1	13	Double Height	New Background	−		=		M	→	m		¾	
	1	1	1	0	15	SO ①	Hold Graphics	.		>		N	↑	n		÷	
	1	1	1	1	16	SI ①	Release ② Graphics	/		?		O	#	o		■	

① These control characters are reserved for compatibility with other data codes

② These control characters are presumed before each row begins

Codes may be referred to by their column and row.
e.g. 2, 5 refers to %

□ Character rectangle

Black represents display colour

White represents background

number (1-8) and its two-digit Page number (00-99).

Different Pages with the same Magazine and Page numbers may be identified by invoking a four-digit Time Code whereby up to 3200 versions of that Page may be individually selected and held.

The 'Hours' and 'Minutes' of the Time Code are not necessarily related to clock-time. The 'Hours Tens' may take any value 0-3 and the 'Minutes Tens' may take any value 0-7.

2.1.4 PAGE SELECTION

A Page may be selected by its Magazine number and Page number, or by its Magazine number, Page number and Time Code.

Neither type of Page selection should respond to Page number 'Units' or 'Tens' in the range 10-15, and selection by Time Code should not respond to 'Minutes Units' or 'Hours Units' in that range, which may be used for other purposes.

2.2 Transmission Sequence

2.2.1 PAGES

The transmission of a selected Page begins with, and includes, its Page-Header and ends with, and excludes, the next Page-Header of the selected Magazine number. All the intermediate Data-Lines carrying the selected Magazine number relate to the selected Page.

Pages may be transmitted in any order. Occasionally incomplete Pages may be transmitted. Rows from Pages of different Magazine number may be interleaved in time.

2.2.2 ROWS

The Rows of a Page may be transmitted in any order. Rows, including the Page-Header, may be repeated in which case the latest apparently error-free information should take precedence. Rows containing no information for display need not be transmitted.

2.2.3 PAGE ERASURE INTERVAL

Rows will be transmitted such as to allow an active television field period between an initial Page-Header and further Rows sufficient to complete the transmission for that Page.

This allows one display period for the receiver Page store to be erased when necessary.

2.3 Page-Header Structure

The Page-Header Data-Lines, see Section 2.1.2, contain eight Hamming Code Bytes in place of the first eight Character Bytes of the other Data-Lines, see Figs. 6 and 7.

There are thus only 32 Character Codes in a Page-Header. They are used to present general information for display, such as the Magazine and Page number, the day and date and the programme source. In particular, the last eight characters are reserved for the display of clock-time. Examples of the content of a Page-Header are given in Fig. 7a.

The locations of the 32 address and control message bits of the eight Hamming Codes peculiar to a Page-Header are shown in Fig. 6. This also shows the binary weights of the eight Page number, and 13 Time Code, bits the functions of which are

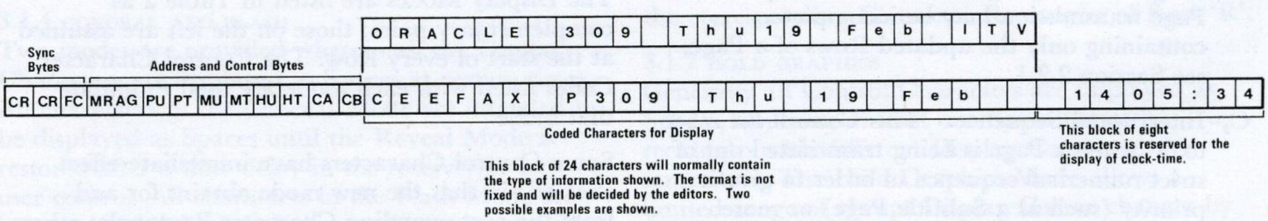


Fig. 7a. Page-Header format.

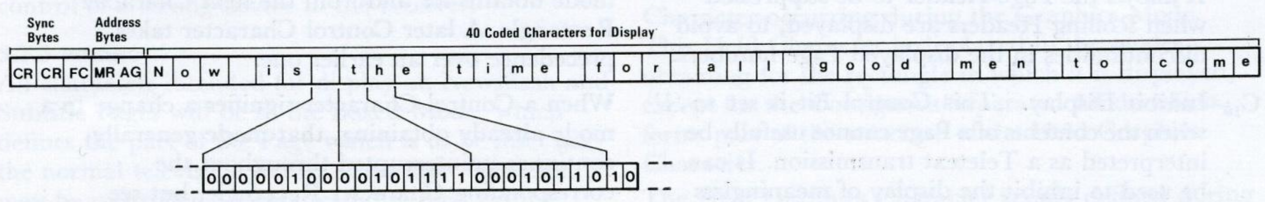


Fig. 7b. Row format.

described in Section 2.1. The remaining 11 bits are Control Bits numbered C_4 to C_{14} and their functions are described below.

2.3.1 CONTROL BITS (see Fig. 6)

C_4–Erase Page. This Control Bit is set to '1' when the information on that Page is significantly different from that in the previous transmission of the Page bearing the same Magazine and Page number, such that the two should not be confused.

Its use will always be followed by a Page erasure interval, see Section 2.2.3.

C_5–Newsflash Indicator. This Control Bit is set to '1' on a Page designated as a 'Newsflash' Page, whether or not it currently contains information. All information intended for display on such a Page will be Boxed, see Section 3.1.5.

C_6–Subtitle Indicator. This Control Bit is set to '1' on a Page designated as a 'Subtitle' Page, whether or not it currently contains information. All information intended for display on such a Page will be Boxed, see Section 3.1.5.

C_7–Suppress Header. This Control Bit is set to '1' when the Page is better displayed without the characters of the Page-Header.

C_8–Update Indicator. This Control Bit may be set to '1' when part or all of a Page contains later information than that in the previous transmission of the Page bearing the same Magazine and Page number. The 'Update' Page transmission may be incomplete, containing only the updated Rows of a Page, see Section 2.2.1.

C_9–Interrupted Sequence. This Control Bit is set to '1' when a Page is being transmitted out of strict numerical sequence in order to give it priority (such as a Subtitle Page) or more frequent transmission (such as an Index Page).

It allows the Page-Header to be suppressed when Rolling Headers are displayed, to avoid discontinuities in the displayed Page numbers.

C_{10}–Inhibit Display. This Control Bit is set to '1' when the contents of a Page cannot usefully be interpreted as a Teletext transmission. It can be used to inhibit the display of meaningless Pages.

C_{11}–Magazine Serial. This Control Bit is set to '1' when the transmission sequence of Magazines and Pages is such that it is preferable to display all Page-Headers as Rolling Headers rather than only those of the selected Magazine.

$\left.\begin{array}{l}C_{12}\\C_{13}\\C_{14}\end{array}\right\}$ Unallocated. It is desirable that these unallocated Control Bits be accessible in decoders for future use as display control functions.

Section 3
PAGE DISPLAY

The 24 Rows of a Page are numbered sequentially from 0 (Page-Header, top Row) to 23. The 40 Character Rectangles of a Row are directly related to the 40 Character Bytes of the corresponding Data-Line, each being assumed to be scanned sequentially from left to right, see Fig. 7.

Every Character Byte contains a Character Code which represents either a Display Character or a Control Character. The Control Characters are used to establish Display Modes, which may be changed between Character Rectangles within a Row.

The Display Modes determine how a Display Character Code is interpreted as a character to be generated in the corresponding Character Rectangle of the Page display. The Character Rectangles corresponding to Control Character Codes are generally displayed as Spaces, but see Section 3.1.7.

3.1 Display Modes

The Display Modes are listed in Table 2 as complementary pairs; those on the left are assumed at the start of every Row. The Control Character Codes listed with each mode are used to initiate that mode.

Some Control Characters have immediate effect ('set at') in that the new mode obtains for and from the corresponding Character Rectangle, others have subsequent effect ('set after') when the new mode obtains for and from the next Character Rectangle. A later Control Character takes precedence over an earlier one.

When a Control Character signifies a change to a mode already obtaining, that mode generally continues uninterrupted throughout the corresponding Character Rectangle, but see Section 3.1.3.

In general the Character Codes of a Row are sufficient to define the entire display of that Row, but see Section 3.1.6.

The interpretation of the Display Modes is detailed below.

3.1.1 CHARACTER SET
Three overlapping sets of 96 Display Characters are available for the interpretation of the 96 Display Character Codes.

During the Alphanumerics Mode the Alphanumerics Set applies. During the Graphics Mode the Contiguous Graphics Set applies during the Contiguous Mode, and the Separated Graphics Set applies during the Separated Mode.

3.1.2 DISPLAY COLOUR
One of the seven colours white, yellow, cyan, green, magenta, red, blue is used to depict the Display Character in the Character Rectangle. Seven pairs of Control Characters are available so that the Display Colour and/or the Alphanumerics/Graphics Mode may be changed by a single Control Character. There is a direct correspondence between bits b_1, b_2, b_3 of these codes and the red, green and blue components of the colours.

3.1.3 BACKGROUND COLOUR
The Background Colour of the Character Rectangles is black during the Black Background mode. Whenever the new background Control Character 1/13, see Table 3, occurs the Display Colour then obtaining is adopted as the Background Colour in the new background mode.

3.1.4 CONCEAL AND FLASH
Two modes are provided wherein all the Display Characters are displayed as Spaces at certain times. All characters in the Conceal Mode are intended to be displayed as Spaces until the Reveal Mode is restored after a time delay in the receiver or by user control. All characters in the Flash Mode are intended to be displayed alternately as they would otherwise be displayed, and as Spaces, under the control of a timing device in the receiver.

3.1.5 BOXING
All characters intended for display on Newsflash and Subtitle Pages will be in the Boxed Mode, which defines the part of the Page which is to be inset into the normal television picture. This inset operation may be controlled automatically by the Control Bits C_5 or C_6, see Section 2.3.1.

Some or all of the characters on any other Pages may be Boxed, the Boxed Mode then defines a part of the Page which may be inset into the normal television picture under user control as an alternative to the display of the complete Page alone, or superimposed on the picture.

In order to give protection against spurious Boxing, two consecutive Start Box Control Characters 0/11, see Table 3, will be transmitted to start the Boxed Mode, and two consecutive End Box Control Characters 0/10 will be transmitted to terminate that mode. The mode changes occur between the corresponding consecutive Character Rectangles.

3.1.6 DOUBLE HEIGHT
Whenever the Double Height Mode occurs the information in that Row is sufficient to define the display of both that Row and the Row of next higher address. A receiver responding to the Double Height Mode on a Row must ignore any information received for the Row of next higher address, but a receiver not responding to this mode will operate normally on both Rows.

A receiver responding to one or more occurrences of the Double Height Mode in Row 'R' will operate as otherwise during that Row except that in every Character Rectangle during the Double Height Mode only the upper half of what would otherwise have been displayed is displayed, stretched vertically to fill the rectangle. On Row 'R+1' the corresponding lower half of each of these is similarly displayed. The remaining Character Rectangles of Row 'R+1' are to be displayed as unboxed Spaces in the same Background Colour as the corresponding Character Rectangles of Row 'R'.

3.1.7 HOLD GRAPHICS
Generally all Control Characters are displayed as Spaces, implying at least one Space between rectangles with different Display Colours in the same Row. The Hold Graphics Mode allows a limited range of abrupt Display Colour changes by calling for the display of a Held Graphics Character in the rectangle corrresponding to any Control Character occurring during the Graphics Mode. This Held Character is displayed in the modes obtaining for the rectangle in which it is displayed, except for the Contiguous/Separated Mode which forms part of the structure of the Held Graphics Character.

The Held Graphics Character is only defined during the Graphics Mode. It is then the most recent

character with $b_6=1$ in its character code, providing that there has been no intervening change in either the Alphanumerics/Graphics or the Normal/Double Height Modes. This character is to be displayed in the Contiguous or Separated Mode as when it was first displayed. In the absence of such a character the Held Graphics Character is taken to be a Space.

Section 4
DEFINITION OF TELETEXT TERMS

Access Time – The time between selecting a Page at a receiver and the first complete reception of that Page.

Alphanumerics Character – One of the 96 Display Characters listed in columns 2, 3, 4, 5, 6 and 7 of Table 3. The shapes of the characters are not defined but they should all be different and recognisable.

Alphanumerics Mode – The Display Mode in which the Display Characters are those of the Alphanumerics Set.

Alphanumerics Set – The set of 96 Display Characters comprising all the Alphanumerics Characters.

Background Colour – The colour filling the parts of the Character Rectangle not occupied by the character itself, see Fig. 8. The Background Colour may be black or one of the seven Display Colours. It may be changed within a Row by Control Characters.

Blast-Through Alphanumerics – The use of the 32 Alphanumerics Characters of columns 4 and 5 of Table 3 during the Graphics Mode.

Boxed Mode – The Display Mode in which, under the user's control, the characters are intended to be inset or added to a television picture. When a Newsflash or Subtitle is transmitted this operation may be automatic under the control of Control Bits.

Broadcast Teletext – The information broadcasting system defined in this document.

Byte – A group of eight consecutive data bits intended to be treated as an entity.

Character Byte – The Byte obtained by appending an odd-parity bit to a Character Code.

Character Code – A seven-bit binary number representing one of a set of Display Characters, or a Control Character.

Character Rectangle – One of the 960 units in the regular matrix of 24 Rows of 40 sites in which characters are generated in the display of a Page.

Character Row – see Row.

Clock Run-In – A sequence of alternating bits at the start of a Data-Line to allow a receiver to achieve bit synchronisation.

Conceal – A Display Mode during which all characters, although stored in the receiver, are intended to be displayed as Spaces until the viewer chooses to Reveal them.

Contiguous Graphics Set – The set of 96 Display Characters comprising the 64 Contiguous Graphics Characters listed in columns 2a, 3a, 6a and 7a of Table 3, together with the 32 Blast-Through Alphanumerics Characters of columns 4 and 5.

Contiguous Mode – The Display Mode in which the six cells of the Graphics Characters fill the Character Rectangle, see Fig. 8.

Control Bits – Each Page-Header contains 11 Control Bits to regulate the display of the Page and its header, see Section 2.3.1.

Control Character – One of the 32 characters listed in columns 0 and 1 of Table 3. Five of these are reserved for compatibility with other data codes. The others are used to alter the Display Modes. They are usually displayed as Spaces, but see Section 3.1.7.

Data-Line – One of the otherwise unused lines of the television field blanking interval used to carry information for one Teletext Character Row. A Data-Line is identified by the Clock Run-In sequence followed by a Framing Code at the appropriate time on a line in the field interval.

Display Character – One of 222 different shapes which can be generated in a Character Rectangle as part of a Page. There are Alphanumerics Characters to provide text, and Graphics Characters to provide elementary pictorial information. There are three sets, the Alphanumerics Set, the Contiguous Graphics Set and the Separated Graphics Set, each of 96 Display Characters, some of which are common.

Display Colour – One of the seven colours (white, yellow, cyan, green, magenta, red, blue) used to depict a Display Character against the Background

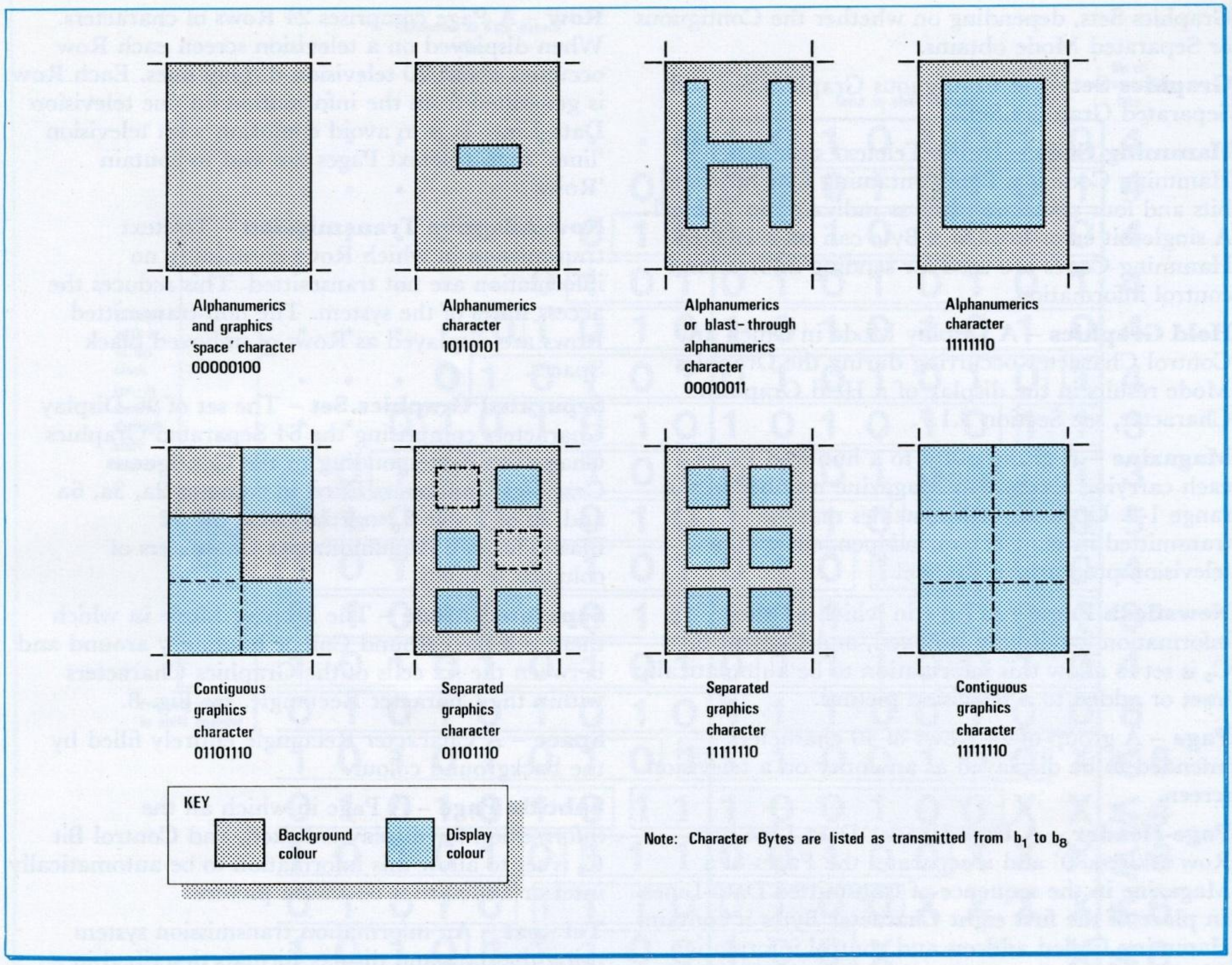


Fig. 8. Examples of Alphanumerics and Graphics displays.

Colour in a Character Rectangle, see Fig. 8. The Display Colour may be changed within a Row by Control Characters.

Display Mode – The way in which the Character Codes corresponding to Display Characters are interpreted and displayed depends on Display Modes established by previous Control Characters, see Table 2. These modes may be changed within a Row, and an initial set of modes is defined for the start of a Row.

Flash – A Display Mode in which all characters are intended to be displayed alternately as they would otherwise be displayed, and as Spaces, under the control of a timing device in the receiver.

Framing Code – A Byte following the Clock Run-In sequence, selected to allow the receiver to achieve Byte synchronisation even if one of its bits is wrongly decoded.

Graphics Character – One of 127 different Display Characters based on the division of the Character Rectangle into six cells, the cells being Contiguous or Separated. The corresponding character codes have $b_6=1$; there is a direct correspondence between the other six bits of the code and the states of the six cells of the Character Rectangle. Examples are given in Fig. 8.

Graphics Mode – The Display Mode in which the Display Characters are those of one or other of the

Graphics Sets, depending on whether the Contiguous or Separated Mode obtains.

Graphics Set – see Contiguous Graphics Set and Separated Graphics Set.

Hamming Code – In the Teletext system a Hamming Code is a Byte containing four message bits and four protection bits as indicated in Table 1. A single bit error in such a Byte can be corrected. Hamming Codes are used for sending address and control information.

Hold Graphics – A Display Mode in which any Control Character occurring during the Graphics Mode results in the display of a Held Graphics Character, see Section 3.1.7.

Magazine – A group of up to a hundred Pages, each carrying a common Magazine number in the range 1-8. Up to eight Magazines may be transmitted in sequence or independently on a television programme channel.

Newsflash Page – A Page in which all the information for display is Boxed, and Control Bit C_5 is set to allow this information to be automatically inset or added to a television picture.

Page – A group of 24 Rows of 40 characters intended to be displayed as an entity on a television screen.

Page-Header – A Page-Header Data-Line has Row address '0' and it separates the Pages of a Magazine in the sequence of transmitted Data-Lines. In place of the first eight Character Bytes it contains Hamming Coded address and control information relating to that Page. Thus the corresponding top Row of the Page has only 32 Character Bytes. These are used for the transmission of general information such as Magazine and Page number, day and date, programme source and clock-time.

Release Graphics – The Display Mode in which Control Characters are invariably displayed as Spaces. It is complementary to the Hold Graphics Mode.

Reveal – The Display Mode complementary to the Conceal Mode.

Rolling Headers – The use of the top Row of the Page to display all the Page-Headers of the selected Magazine (see Section 2.3.1 – Magazine Serial) as they are transmitted. This gives an indication of the Page transmission sequence while the user is watching, or awaiting, a selected Page.

Row – A Page comprises 24 Rows of characters. When displayed on a television screen each Row occupies about 20 television display lines. Each Row is generated from the information on one television Data-Line. It is to avoid confusion with television 'lines' that Teletext Pages are said to contain 'Rows'.

Row-Adaptive Transmission – Teletext transmission in which Rows containing no information are not transmitted. This reduces the access times of the system. The non-transmitted Rows are displayed as Rows of unboxed black Spaces.

Separated Graphics Set – The set of 96 Display Characters comprising the 64 Separated Graphics Characters corresponding to the Contiguous Graphics Characters listed in columns 2a, 3a, 6a and 7a of Table 3, together with the 32 Blast-Through Alphanumerics Characters of columns 4 and 5.

Separated Mode – The Display Mode in which there is a Background Colour boundary around and between the six cells of the Graphics Characters within the Character Rectangle, see Fig. 8.

Space – A Character Rectangle entirely filled by the background colour.

Subtitle Page – A Page in which all the information for display is Boxed, and Control Bit C_6 is set to allow this information to be automatically inset or added to a television picture.

Teletext – An information transmission system using the data and display formats described in Sections 2 and 3 of this document.

Television Data-Line – see Data-Line.

Time-Coded Page – In addition to a Magazine number and Page number a Page may be assigned a 'Time Code' of one of 3200 numbers arranged as two 'Hours' digits and two 'Minutes' digits. This code may be used to select one of many Pages, bearing the same Magazine and Page number, transmitted in sequence. When the transmission of each version of the Page is isolated or infrequent, this code may be made literally the 'Hours' and 'Minutes' of the clock-time at which it is transmitted.

Time Display – The last eight characters of every Page-Header are reserved for clock-time. A receiver may be arranged to display these characters from the Rolling Headers to give a clock-time display.

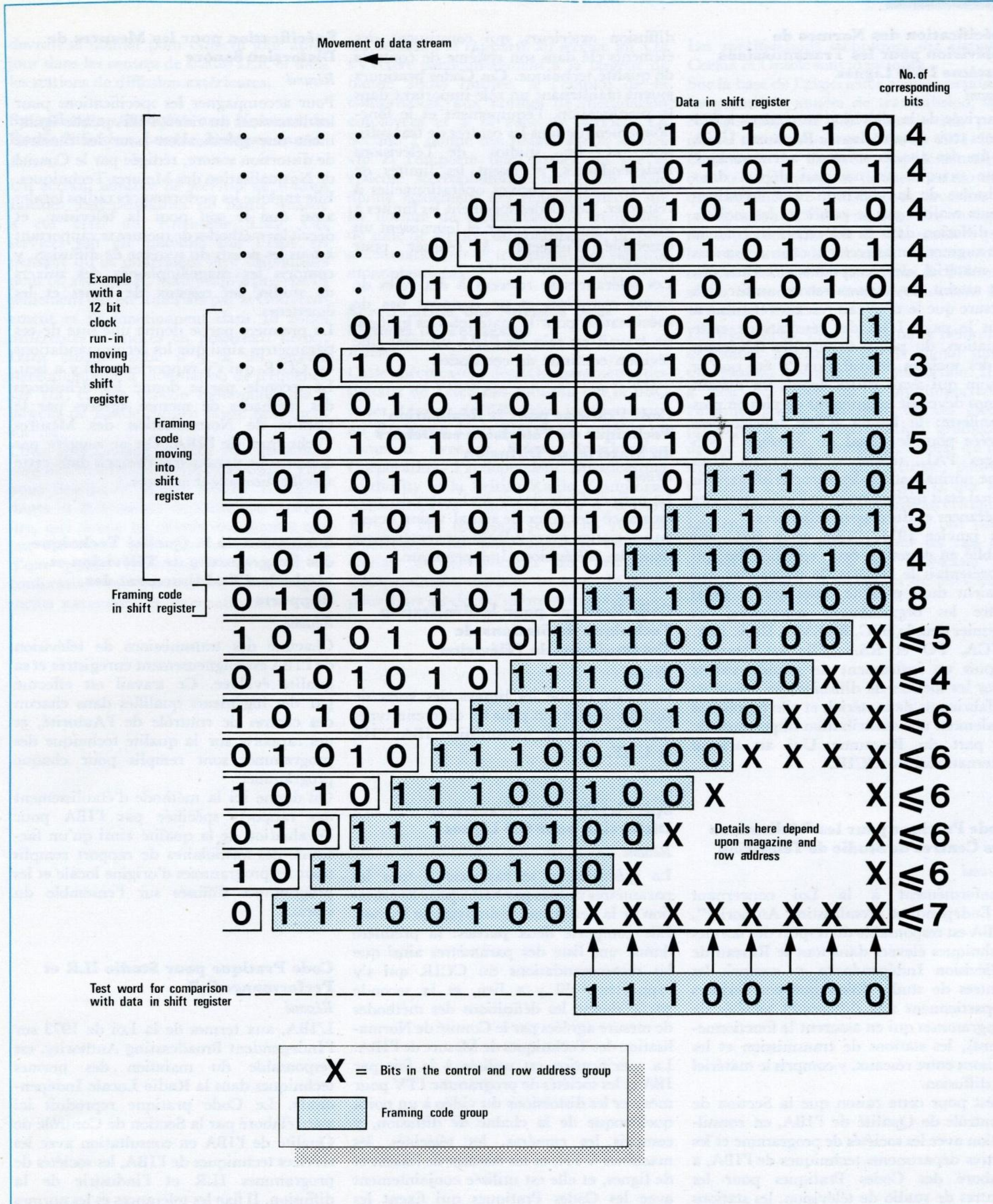


Fig. 9. Idealised operation of Framing Code. Diagram showing contents of shift register in each clock period.

Spécification des Normes de Télévision pour les Transmissions Système I 625 Lignes

Résumé

L'arrivée de la télévision en couleur à 625 lignes trois canaux dans le Royaume Uni à la fin des années soixante a en quelque sorte marqué un nouveau départ dans l'histoire de la télévision. Les investissements réalisés par le public et les sociétés de diffusion dans la télévision en couleur ont augmenté massivement et les demandes en matériel, des récepteurs aux caméras, ont atteint des niveaux record au fur et à mesure que le nouveau réseau s'étendait à tout le pays. L'un des résultats de cette situation, du point de vue des fabricants et des sociétés de diffusion, a été que le besoin qui avait existé depuis un certain temps devenait maintenant de plus en plus manifeste: le besoin d'une spécification agréée pour le signal du Système I 625 lignes PAL, utilisé au Royaume Uni. Une normalisation des caractéristiques du signal était nécessaire, avec l'indication des tolérances et distorsions autorisées.

En janvier 1971, l'IBA et la BBC ont publié en commun cette spécification qui représentait le résultat de discussions qui avaient duré près de deux ans et demi entre les organisations concernées en premier lieu, la BBC, BREMA, EEA, IBA, ITCA, PO et RSA. Elle est devenue depuis un instrument de grande valeur pour les sociétés de diffusion, les créateurs et fabricants de matériel, et elle représente également une contribution importante de la part du Royaume Uni au travail international du CCIR.

Code Pratique pour les Réalisations des Centres de Studio de Télévision

Résumé

Conformément à la Loi concernant l'"Endependant Broadcasting Authority", l'IBA est responsable du respect des normes techniques élevées dans tout le Réseau de Télévision Indépendante y compris les centres de studio (bien que ces derniers appartiennent aux différentes sociétés de programmes qui en assurent le fonctionnement), les stations de transmission et les liaisons entre réseaux, y compris le matériel de diffusion.

C'est pour cette raison que la Section de Contrôle de Qualité de l'IBA, en consultation avec les sociétés de programme et les autres départments techniques de l'IBA, a élaboré des Codes Pratiques pour les centres de studio de télévision, les stations de transmission et les équipements de diffusion extérieurs, qui constituent des éléments clé dans son système de contrôle de qualité technique. Ces Codes pratiques jouent maintenant un rôle important dans la planification, l'équipement et le fonctionnement de tous les centres de transmission et de studios de Télévisions Indépendantes, et fixent les limites de tolérance et les normes opérationnelles à respecter. Ces Codes spécifient les limites à atteindre jour après jour et fournissent un ensemble d'objectifs à réaliser pour l'ingénieur des opérations.

Les tolérances se réfèrent à des voies de signal complètes et ne donnent pas de spécification pour le matériel. Des groupes de travail au sein de l'IBA assurent une révision continue de ces Codes.

Code Pratique pour la Réalisation Technique de Télévision en Dehors du Matériel de Diffusion

Résumé

Le présent Code donne les limites de performance des voies de signal vision et son en association avec les Diffusions extérieures dans la Télévision Indépendante.

Code Pratique pour la Réalisation Technique de Stations de Transmission de Télévision

Résumé

Ce Code donne les limites des voies de signal vision et son pour les différents types d'installations de transmission IBA VHF et UHF.

Spécification des Mesures de Distorsion pour 625 Lignes

Résumé

La spécification se rapporte à tous les paramètres utilisés par l'IBA pour l'évaluation de la performance du Système I vidéo. Elle comporte deux parties: la première donne une liste des paramètres ainsi que les recommandations du CCIR qui s'y rapportent, s'il y a lieu, et la seconde partie donne les définitions des méthodes de mesure agréées par le Comité de Normalisation des Techniques de Mesure de l'IBA.

La spécification est utilisée à la fois par IBA et les sociétés de programme ITV pour mesurer les distorsions du vidéo à un point quelconque de la chaîne de diffusion, y compris les caméras, les télécinés, les machines VTR, et les réseaux de liaison et de lignes, et elle est utilisée conjointement avec les Codes Pratiques qui fixent les tolérances pour les différents paramètres.

Spécification pour les Mesures de Distorsion Sonore

Résumé

Pour accompagner les spécifications pour les distorsions du vidéo, l'IBA publie également une spécification pour les mesures de distorsion sonore, rédigée par le Comité de Normalisation des Mesures Techniques. Elle englobe les performances radios locales ainsi que le son pour la télévision, et décrit les méthodes de mesure se rapportant à tous les points du système de diffusion, y compris les magnétophones, les mixers de studio, les réseaux de lignes et les émetteurs.

La première partie donne une liste de ces paramètres ainsi que les recommandations du CCIR qui s'y rapportent, s'il y a lieu. La seconde partie donne les définitions des méthodes de mesure agréées par le Comité de Normalisation des Mesures Techniques de l'IBA. On ne suggère pas que tous les paramètres compris dans cette spécification soient mesurés.

Evaluation de la Qualité Technique des Programmes de Télévision et Méthode d'Etablissement des Rapports

Résumé

Chacune des transmissions de télévision de l'IBA est soigneusement enregistrée et sa qualité évaluée. Ce travail est effectué par des ingénieurs qualifiés dans chacun des centres de contrôle de l'Autorité, et des rapports sur la qualité technique des programmes sont remplis pour chaque programme.

On donne ici la méthode d'établissement des rapports spécifiée par l'IBA pour l'évaluation de la qualité ainsi qu'un facsimile des formulaires de rapport remplis pour les programmes d'origine locale et les programmes diffusés sur l'ensemble du réseau.

Code Pratique pour Studio ILR et Performance O-B

Résumé

L'IBA, aux termes de la Loi de 1973 sur l'Independent Broadcasting Authority, est responsable du maintien des normes techniques dans la Radio Locale Indépendante. Le Code pratique reproduit ici a été élaboré par la Section de Contrôle de Qualité de l'IBA en consultation avec les services techniques de l'IBA, les sociétés de programmes ILR et l'industrie de la diffusion. Il fixe les tolérances et les normes opérationnelles de performance que l'on

devrait se donner pour objectif jour après jour dans les centres de studio ILR et dans les stations de diffusion extérieures.

Spécification Relative aux Normes de Radiodiffusion Locale Indépendante

Résumé

Un certain nombre de services de Radios Locales Indépendantes de haute qualité a été créé au Royaume Uni. Ces services ont été planifiés par l'IBA en pensant qu'ils pourraient être disponibles pour 60 zones ILR, mais jusqu'à présent 19 seulement ont été autorisés par le Gouvernement et ils fonctionnent dans 18 zones différentes (Londres en possédant deux). Dans chaque zone il y a un service stéréophonique à modulation de fréquence sur vhf, et une version monophonique à largeur de bande limitée existe également sur mf.
Cette spécification devrait étre consultée conjointement avec le Code Pratique IBA pour Studio de Radio Locale Indépendante et Réalisation de Diffusion extérieure, qui donne les détails des normes qui ont été fixées pour assurer le maintien d'une qualité technique adéquate, et la conformité des transmissions aux réglements nationaux et internationaux.
La Section 1 se rapporte au service mf. On s'y réfère particulièrement à la largeur de bande audio limitée, à l'emploi de la compression, aux normes de modulation employées et à la zone de service. La Section 2 donne des détails sur le service vhf et comporte une explication sur le système stéréophonique ton pilote. Elle donne également des renseignements sur les normes de modulation de fréquence, de zone de service, de polarisation, de pré-accentuation, et le traitement des signaux monophoniques.

Specification des Normes pour Signaux de Télétextes

Résumé

Cette spécification décrit les paramètres des signaux de Télétextes transmis par la BBC et les Réseaux de Télévision indépendante au Royaume Uni. Elle a été publiée en commun avec la British Broadcasting Corporation, l'Independent Broadcasting Authority et la British Radio Equipment Manufacturers' Association, en septembre 1976, et elle remplace toutes les versions antérieures. La BBC utilise le nom de Ceefax et les Sociétés de Télévision Indépendantes utilisent le nom d'Oracle pour leurs services d'information publique.
Les spécifications techniques des signaux Ceefax et Oracle sont identiques.
Sur la base de l'expérience acquise pendant les premières années de transmission, des changements ont été apportés aux premières spécifications publiées en 1974. Des Caractères de Contrôle Supplémentaires ont été attribués pour donner des moyens qui peuvent être utilisés pour favoriser la présentation de l'information. Ces changements ont été effectués de telle manière que les transmissions futures demeureront compatibles avec les décodeurs de Télétext sur la base des dernières spécifications du 13 janvier 1976.
Les distorsions, bruits et signaux déformés dégradent inévitablement le signal dans une plus ou moins grande proportion. Il y a lieu de noter un point important: l'augmentation d'ampleur de ces effets provoquera une détérioration graduelle de la télévision analogue, alors qu'un signal digital, come le Télétexte, pourra continuer à être décodé jusqu'à ce que les perturbations dépassent un niveau critique. Les études faites sur le terrain ont confirmé que dans presque tous les cas, ce niveau critique pour les Télétextes se produit lorsque la réception de télévision est déjà mauvaise.

Normvorschrift für die Übertragung des 625-Zeilen System I

Kurzfassung

Die Ankunft des 3-Kanal Farbfernseh-Dienstes in Großbritannien gegen Ende der sechziger Jahre bedeutete einen wichtigen Wendepunkt in der Geschichte des Fernsehens. Die Investierung im Farbfernsehen durch die Öffentlichkeit, Rundfunk und Fernsehindustrie zeigte einen wesentlichen Anstieg und der Gerätebedarf, vom Empfänger bis zur Farbfernseh-Kamera, erreichte Rekordhöhen, als sich der neue Fernsehdienst national verbreiterte. Vom Standpunkt der Gerätebau, Rundfunk und Fernsehindustrie aus gesehen bestand schon seit Langem ein Brauch–der Brauch für eine allgemein anerkannte Norm des in Großbritannien verwendeten PAL Videosignales für das 625-Zeilen System I. Eine Normvorschrift der Signalmerkmale zusammen mit den erlaubten Toleranzen und Verzerrungen war erfordert.
Im Jänner 1971 wurde diese Vorschrift von der BBC und IBA gemeinschaftlich als Ergebnis einer zweieinhalb Jahre langen Diskussion zwischen den betreffenden Organisationen wie die BBC, BREMA, EEA, IBA, ITCA, PO und RSA, herausgegeben. Im Laufe der folgenden Jahre bewies sich diese Vorschrift als ein wertvolles Dokument für die Fernseh, Geräte-Entwicklungs und Herstellerindustrie und bedeutet ebenfalls einen wertvollen Beitrag für die internationale Arbeit der CCIR.

Betriebsvorschrift für das TV-Studio Zentrum

Kurzfassung

Unter den Bedingungen des IBA Aktes ist IBA für die Erhaltung der erforderlichen hohen technischen Normen innerhalb des Netzwerkes des Independent Television einschließlich von Studiozentren (obwohl diese von den verschiedenen Programmgesellschaften geführt werden), Sendeanlagen und Netzwerkstrecken wie Außenübertragungen, verantwortlich.
Aus diesen Gründen hat die IBA Quality Control Section in Vereinbarung mit Programmgesellschaften und weiteren technischen Sektionen der IBA eine detailierte Betriebsvorschrift für Studiozentren, Sendeanlagen und Einrichtungen für Außenübertragungen aufgestellt. Diese Vorschriften spielen eine wichtige Rolle in der Planung, Einrichtung und Arbeitsweise der Studio und Sendezentren des Independent Television und legen Toleranzgrenzwerte und Betriebsnormen fest, die an einer Tagesbasis anzustreben sind.
Die Toleranzen beziehen sich auf komplette Signalstrecken und beschreiben nicht die Leistungswerte der Geräte. Arbeitsgruppen innerhalb der IBA befassen sich mit einer fortlaufenden Untersuchung der Vorschriften.

Betriebsvorschrift für die technischen Leistungsnormen der Einrichtung für Außenübertragung

Kurzfassung

Die Betriebsvorschrift legt die Leistungsgrenzwerte für die mit den Außenübertragungen des Independent Television verbundenen Video und Tonsignalwegen fest.
(Siehe Kurzfassung auf Seite 21.)

Betriebsvorschrift für die technischen Leistungsnormen von Fernseh-Sendestationen

Kurzfassung

Die Betriebsvorschrift legt die Leistungsgrenzwerte für Video und Tonsignalwege der verschiedenen Typen von VHF und UHF Sendeanlagen der IBA fest.
(Siehe Kurzfassung auf Seite 21.)

Vorschrift für Messungen von 625-Zeilen Video-Signal verzerrungen

Kurzfassung

Die Vorschrift befaßt sich mit den, von der IBA für die Beurteilung des System I Videosignales, verwendeten Kenngrößen und besteht aus zwei Teilen: der Erste führt eine Zusammenstellung der Kenngrößen zusammen mit CCIR vorgeschlagenen Werten an. Der zweite Abschnitt führt die, vom IBA Komitee für die Normung von Meßmethoden beschlossenen Definitionen für Meßdurchführungen an. Die Vorschrift, zusammen mit den in der Betriebsvorschrift festgelegten Normtoleranzen, wird von IBA und den ITV Programmgesellschaften für die Messung von Videoverzerrungen im Sendenetz einschließlich Fernsehkameras, Telecine, VTR, Richtfunkstrecken und Netzwerkstrecken, verwendet.

Vorschrift für die Messung von Ton-Verzerrungen

Kurzfassung

Ähnlich der Vorschrift für Videoverzerrungen hat IBA auch eine Vorschrift für die Messung von Tonverzerrungen herausgegeben. Diese Vorschrift wurde vom Komitee für die Normung von Meßmethoden entworfen und bezieht sich sowohl auf Local Radio als auch auf den Fernsehton und legt die Meßverfahren an verschiedenen Stellen des Sendenetzes, wie Tonbandgeräte, Studio-Mischer, Netzwerk-Strecken und Sender, fest.
Teil I führt eine Zusammenstellung der Kenngrößen zusammen mit CCIR Vorschlägen an.
Teil II legt die Definitionen der einzelnen Meßverfahren, wie vom Komitee für die Normung von Meßmethoden entschieden, fest. Eine Messung aller angeführten Kenngrößen wird nicht angedeutet.

Technische Qualitätserfassung und Berichterstattung von Fernsehprogrammen

Kurzfassung

Jedes von IBA übertragene Programm wird sorgfältig erfaßt und für die technische Qualität überprüft. Die Durchführung erfolgt durch Fachpersonal in den Kontrollzentren der IBA und Berichte über die technische Qualität der einzelnen Programme werden ausgefüllt.
Ebenfalls angeführt ist das, von der IBA vorgeschriebene Bericht verfahren für die qualitätsmäßige Erfassung zusammen mit Faksimile-Berichtformularen für Lokal und Netzwerk programme.

Vorschrift für die Übertragungsnormen von Teletext

Kurzfassung

Diese Vorschrift beschreibt die Kenngrößen für den, in Großbritannien von der BBC und Independent Television übertragenen, Teletext Dienstes. Dieses Dokument wurde von der British Broadcasting Corporation zusammen mit der Independent Broadcasting Authority und British Radio Equipment Manufacturers' Association im September 1976 herausgegeben und ersetzt alle früheren Vorschriften. Der unter der Berzeichnung CEEFAX laufende Dienst der BBC ist unter dem Namen ORACLE von IBA bekannt. Die technischen Grundlagen und Normen sind für ORACLE und CEEFAX Datensignale gleichbedeutend.
Die Erfahrung von Datenübertragungen innerhalb der ersten Jahre veranlaßte eine Änderung der Vorschrift vom Oktober 1974. Durch die Zuteilung und den Gebrauch weiterer Sonderzeichen wird eine Verbesserung der Informationsanzeige ermöglicht. Diese Änderungen wurden so durchgeführt daß zukünftige Teletext-Übertragungen mit den, auf den Normen der Vorschrift vom 13. Jänner 1976

beruhenden Teletext-Decoder, vereinbar sind.

Teletext-Signale werden durch Verzerrungen, Rauschen und Störsignalen mehr oder weniger beeinträchtigt. Besonders ist zu bemerken daß eine Erhöhung dieser Einflüsse eine allmähliche Verschlechterung des analogen Videosignales ergibt, wobei ein Digitalsignal wie Teletext noch immer bis zu einem kritischen Störungsniveau dekodierbar ist. Untersuchungen zeigten daß in den meisten Fällen dieses kritische Störungsniveau für Teletext nur dann auftritt wenn bereits ein schlechter Fernsehempfang vohanden war.

Vorschrift für die Übertragungsnormen des Independent Local Radio

Kurzfassung

Eine Reihe von Independent Local Radio Diensten hohen Qualitätsgrades wurden in Großbritannien in Betrieb genommen. Diese wurden von IBA, auf der Basis daß diese in Zukunft für 60 ILR Bereiche gültig sind, geplant. Bisher wurden nur 19 Stationen für 18 verschiedene Bereiche (zwei für London) vom Staat genehmigt. Jeder Bereich wird durch einen FM-Stereo Dienst im VHF Band versorgt. Ein Bandbegrenztes Mono Signal wird auf MW ausgestrahlt.
Diese Vorschrift soll zusammen mit der IBA Betriebsvorschrift für Independent Local Radio Studio und Außenübertragung gelesen werden, welche die, für die Erhaltung der technischen Qualität, nach nationalen und internationalen Regeln festgelegten Normen anführt. Teil I befaßt sich mit dem MW Dienst und bezieht sich besonders auf die Bandbreiten-Begrenzung, die Kompressor Anwendung, die verwendeten Modulationsnormen und den Dienstbereich.
Teil II befaßt sich mit Details des VHF Dienstes und beinhaltet weiters eine Erläuterung des ,,Pilot-Tone" Stereo systems, der FM Modulationsnormen, der Pre-emphasis, des Dienstbereiches, der Polarisation und der Verarbeitung des Monosignales.

Betriebsvorschrift für die Leistungsnormen von ILR und Außenübertragungen

Kurzfassung

Die IBA ist unter den Bedingungen des IBA Aktes 1973 für die Erhaltung der technischen Normen für Independent Local Radio verantwortlich. Die hier angeführte Vorschrift wurde von der IBA Quality Control Section mit Vereinbarung weiterer technischen Sektionen der IBA, den ILR Programmgesellschaften und der Rundfunk und Fernsehindustrie zusammengestellt. Die Vorschrift legt die, an einer Tagesbasis anzustrebenden Toleranzen und Arbeitsnormen für das Betriebsverhalten von ILR Studiozentren und Außenübertragungs-Stellen fest.

Especificación de las Normas de Televisión para las Transmisiones del Sistema I 625 Líneas

Resumen

Cuando la televisión en color de 625 líneas tres canales fue lanzada en el Reino Unido a finales de los años sesenta, se marcó, en cierto modo, un nuevo comienzo en la historia de la televisión. Las inversiones realizadas por el público y las sociedades de difusión en la televisión en color, aumentaron masivamente y las solicitudes de material, desde los receptores hasta las cámaras, alcanzaron alturas record a medida que la red se extendía a todo el país. Uno de los resultados de esta situación, desde el punto de vista de los fabricantes y de las sociedades de difusión, fue que la necesidad existente desde hacía cierto tiempo era, ahora, mucho más evidente: la necesidad de poseer una especificación oficial para la señal del sistema I 625 líneas PAL, empleada en el Reino Unido. Una normalización de las características de la señal era pues necesaria con la indicación de las tolerancias y distorsiones autorizadas.

En Enero de 1971, la IBA y la BBC publicaron en común esta especificación que representaba el resultado de negociaciones que habían durado cerca de dos años y medio entre las organizaciones concernidas en primer lugar, la BBC, BREMA, EEA, IBA, ITCA, PO y RSA. Desde entonces se ha convertido en un instrumento de un gran valor para las sociedades de difusión, los creadores y fabricantes de material, representando además una contribución importante por parte del Reino Unido al trabajo internacional del CCIR.

Código Práctico para las Realizaciones de los Centros de Estudios de Televisión

Resumen

De acuerdo con la ley referente a la "Independent Broadcasting Authority", la IBA es responsable del respeto de las normas técnicas implantadas en toda la Red de Televisión Independiente, incluidos los centros de estudios (a pesar de que estos últimos pertenecen a las diferentes sociedades de programas que aseguran el funcionamiento), las estaciones de transmisión y los enlaces entre redes, incluyendo el material de difusión.

Por esta razón, la sección de Control de Calidad de IBA, en colaboración con las sociedades de programas y los otros departamentos técnicos de IBA, ha elaborado Códigos Prácticos para uso de los Centros de Estudios de televisión, las estaciones de transmisión y los equipos de difusión exteriores, que constituyen el elemento básico de su sistema de control de calidad técnica. Estos Códigos Prácticos tienen ahora un papel importante en la planificación, el equipo y el funcionamiento de todos los centros de transmisión y estudios de las Televisiones Independientes y determinan los límites de tolerancia, asi como las normas operacionales que deben ser respetadas. Estos Códigos especifican los límites que deben ser alcanzados día tras día y suministran un conjunto de objetivos que deben ser realizados por parte del ingeniero de operaciones.

Las tolerancias se refieren a canales de señal completos y no suministran especificación para el material. En el seno de IBA, grupos de trabajo aseguran una revisión continua de estos Códigos.

Código Práctico para la Realización Técnica de Televisión Fuera del Material de Difusión

Resumen

El presente Código especifica los límites de prestación de los canales de la señal visión y sonido, en asociación con las Difusiones Exteriores en la Televisión Independiente.

Código Práctico para la Realización Técnica de Estaciones de Transmisión de Televisión

Resumen

Este Código especifica los límites de los canales de la señal visión y sonido para los diferentes tipos de instalaciones de transmisión IBA, VHF y UHF.

Especificaciones de las Medidas de Distorsión para 625 Líneas

Resumen

La especificación se refiere a todos los parámetros empleados por IBA para la evaluación de la prestación del Sistema I video. Comprende dos partes: la primera presenta una lista de los parámetros, asi como de las recomendaciones del CCIR referentes a ellos, si llega el caso; la segunda parte suministra las definiciones de los métodos de medida adminidos por el Comité de Normalización de las Técnicas de Medida de IBA.

La especificación es empleada al mismo tiempo por IBA y por las sociedades de programas de ITV para medir las distorsiones video en un punto cualquiera de la cadena de difusión, incluidas las cámaras, los telecines, las máquinas VTR, asi como las redes de enlaces y de líneas. Es empleada conjuntamente con los Códigos Prácticos que determinan las tolerancias para los diferentes parámetros.

Especificación para las Medidas de Distorsión Sonora

Resumen

Para acopañar las especificaciones referentes a las distorsiones video, la IBA publica tambien una especificación referente a las medidas de distorsión sonoras, redactada por el Comité de Normalización de las Medidas Técnicas. Comprende las prestaciones radios locales, así como el sonido para la televisión y describe los métodos de medida referentes a todos los puntos del sistema de difusión, incluidos los magnetofones, los mezcladores de estudio, las redes de líneas y los emisores.

La primera parte presenta una lista de estos parámetros, así como las recomendaciones del CCIR que se refieren a ellos, si llega el caso. La segunda parte presenta las definiciones de los métodos de medida admitidas por el Comité de Normalización de las Medidas Técnicas de IBA. No se sugiere que todos los parámetros incluidos en esta especificación sean medidos.

Evaluación de la Calidad Técnica de los Programas de Televisión y Método para Establecer los Informes

Resumen

Cada una de las transmisiones de televisión de IBA es registrada cuidadosamente y su calidad es evaluada. Este trabajo es efectuado en cada uno de los centros de control de la Autoridad por ingenieros calificados que emiten informes referentes a la calidad técnica para cada uno de los programas.

Se presenta aqui el método de establecimiento de los informes, especificado por IBA para la evaluación de la calidad, así como un facsímile de los formularios de informe cumplimentados para los programas de origen local y los programas difundidos en el conjunto de la red.

Código Práctico para Estudio ILR y Prestación Ob

Resumen

Según los términos de la Ley de 1973 sobre el Independent Broadcasting Authority, IBA es responsable del mantenimiento de las normas técnicas en la Radio Local Independiente. El Código Práctico que se reproduce aqui, ha sido elaborado por la Sección de Control de Calidad de

IBA, en colaboración con los servicios técnicos de IBA, las sociedades de programas ILR y la industria de la difusión. Determina las tolerancias y normas operacionales de prestación que deberían constituir el objetivo cotidiano en los estudios ILR y en las estaciones de difusión exteriores.

Especificación Referente a las Normas de Radiodifusion Local Independiente

Resumen

Un cierto número de servicios de Radios Locales Independientes de alta calidad han sido creados en el Reino Unido. Estos servicios han sido planificados por IBA, pensando que podrían encontrarse disponibles para 60 zonas ILR, pero hasta el momento, solo 19 fueron autorizados por el Gobierno y funcionan en 18 zonas diferentes (Londres posee dos). En cada una de las zonas existe un servicio estereofónico de modulación de frecuencia en VHF y una versión monofónica de anchura de banda limitada que existe también en MF.

Esta especificación debería ser consultada conjuntamente con el Código Práctico de IBA para Estudio de Radio Local Independiente y Realización de Difusión Exterior, que suministra los detalles de las normas que han sido determinadas para asegurar el mantenimiento de una calidad técnica adecuada y la conformidad de las transmisiones con los reglamentos nacionales e internacionales.

La sección 1 se refiere al servicio MF. Se especifica en particular la anchura de banda audio limitada, el empleo de la compresión, las normas de modulación empleadas y la zona de servicio. La sección 2 suministra detalles sobre el servicio VHF y comprende una explicación sobre el sistema estereofónico de sintonía pilotada. Presenta tambien informaciones sobre las normas de modulación de frecuencia, zona de servicio, polarización, preacentuación y tratamiento de las señales monofónicas.

Especificación de las Normas para Señales de Teletextos

Resumen

Esta especificación describe los parámetros de las señales de Teletextos transmitidos por la BBC y las Redes de Televisión Independiente en el Reino Unido. Ha sido publicada conjuntamente con la British Broadcasting Corporation, la Independent Broadcasting Authority y la British Radio Equipment Manufacturers' Association, en septiembre de 1976 y reemplaza todas las versiones anteriores. La BBC emplea el nombre de CEEFAX y las Sociedades de Televisión Independientes el nombre de ORACLE para sus servicios de información pública. Las especificaciones técnicas de las CEEFAX y ORACLE son idénticas. Sobre la base de la experiencia adquirida durante los primeros años de transmisión, se ha aportado cambios a las primeras especificaciones publicadas en 1974. Se han atribuido carácteres de Control Suplementarios para suministrar medios que pueden ser utilizados para favorizar la presentación de la información. Estos cambios han sido efectuados de tal manera que las futuras transmisiones continuarán siendo compatibles con los descodificadores de Teletextos, sobre la base de las últimas especificaciones del 13 de Enero de 1976.

Las distorsiones, ruidos y señales deformadas, degradan inevitablemente la señal en una mayor o menor proporción. Conviene tener en cuenta un punto importante: el aumento de amplitud de estos efectos, provocará un deterioro gradual de la televisión analógica, mientras que una señal digital, como el teletexto, podrá continuar a ser descodificada hasta que las perturbaciones rebasen un nivel crítico. Los estudios Ilevados a cabo en este sentido, han confirmado en casi todos los casos, este nivel crítico para los Teletextos, que se produce cuando la recepción de televisión es ya mala.

Published by the Independent Broadcasting Authority

Printed in England by The Hawkesby Printing Co. Ltd.

IBA TECHNICAL REVIEW

1 Measurement and Control*

2 Technical Reference Book, edition 3

3 Digital Television*

4 Television Transmitting Stations

5 Independent Local Radio

6 Transmitter Operation and Maintenance

7 Service Planning and Propagation

8 Digital Video Processing – DICE

9 Digital Television Developments

*Out of print

IBA INDEPENDENT BROADCASTING AUTHORITY